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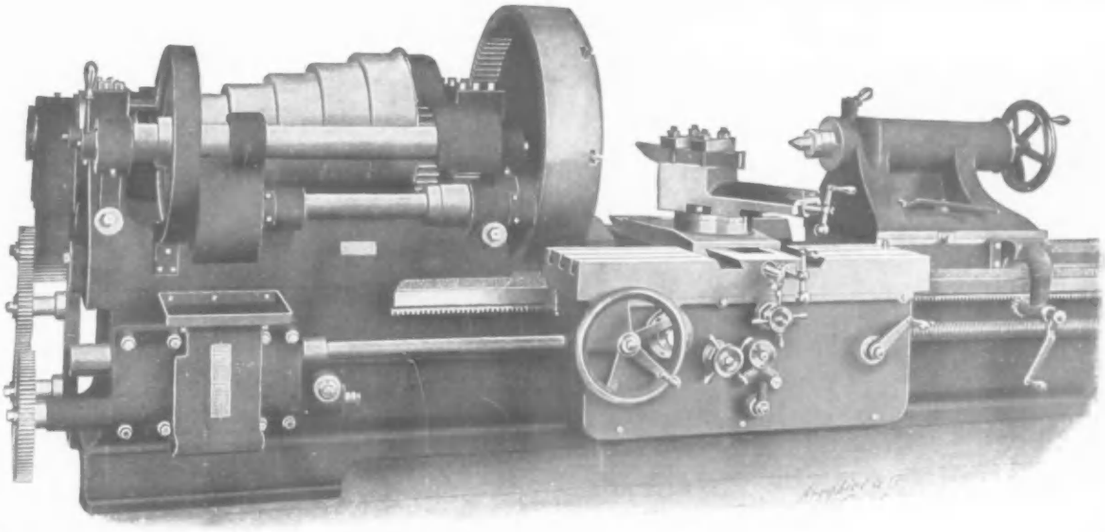
Index to Advertisers and Classified Index Following Reading Matter.



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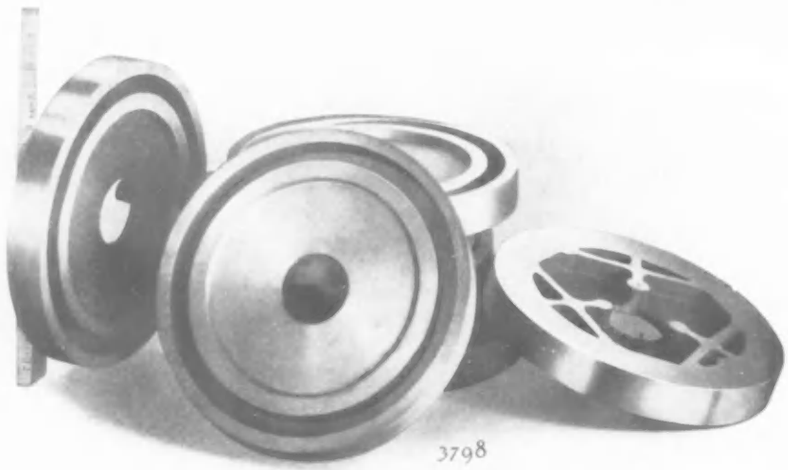

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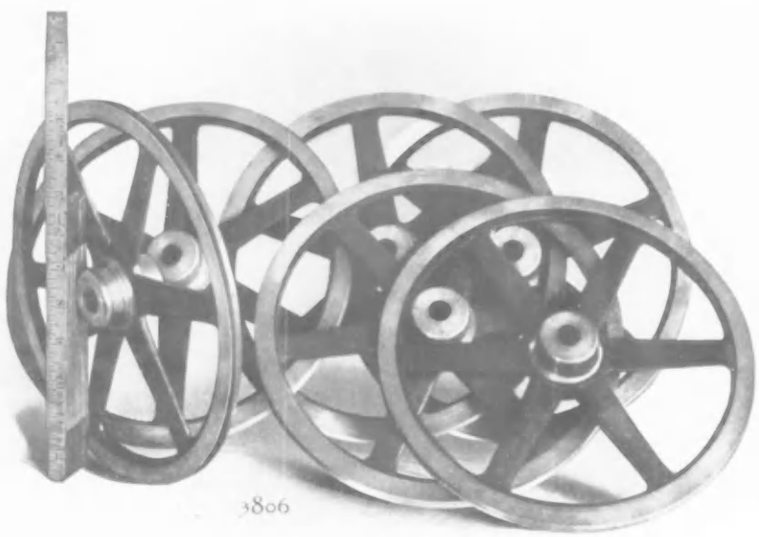

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A Clock with a Forty-foot Dial

The Latest Achievement in Clock Construction by the Seth Thomas Clock Company in Which the Hand Moves 23 Inches a Minute

SPECIAL CORRESPONDENCE

When we speak of clocks and clock-making we are very apt to think of the alarm clock with its spiteful ring that always comes when you are the sleepiest, and which sells for 67 cents in the department store. But this clock is a little different proposition as the dial is 40 feet 6 inches in diameter, or about as high as a four-story house with the ordinary gable roof. Standing, as it does, on the top of an eight-story concrete building overlooking the North river on the Jersey City

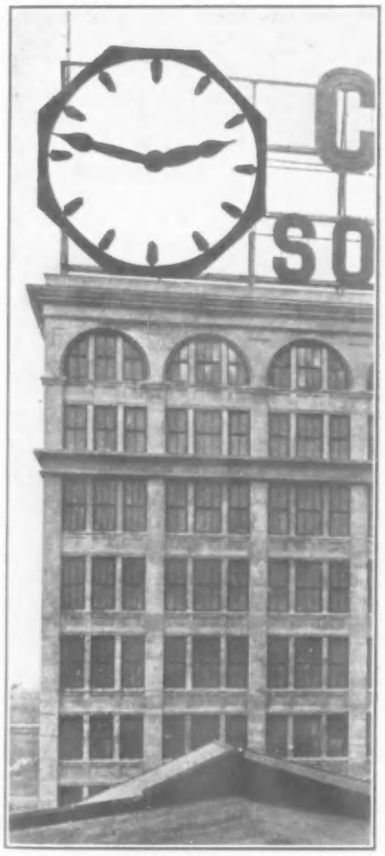


FIG. 1. THE LARGE CLOCK ON BUILDING

side where it can be seen from practically the entire river front of New York, it presents a striking appearance, and is a public convenience. The center of the dial is 145 feet above the street.

In common with all clocks of this type the hands are not driven direct by the clock movement, but the time train is down at the base of the clock and merely controls the movement of the hand, the actual movement being accomplished by weights on ropes which move the hands whenever the clock works allow them to work. The weights foot up to about 1500 pounds, so as to provide ample driving power to overcome all wind resistance, and when this is directly against the hands it amounts to considerable as well as putting quite a bending strain on the shafts which carry the hands.

This clock is the latest achievement of the Seth Thomas Clock Company, of Thomaston, Conn., which began making clocks in 1811, just 97 years ago, and is perhaps the father of all clock making in the United States. The clock has been made for Colgate & Co., another centurion, but in the soap business, and is supposed to be the biggest ever.

The Clock that Keeps the Time

The bed of the clock proper is five feet long, of which the time train occupies only about one-third, as shown in Fig. 3. The wheels and gears are all cut from solid bronze and the steel pinions are hardened. The main time wheel is a little over 18 inches in diameter and the gravity escapement of Dennison, who afterward was made over into Sir Edmund Becket on account of inventing the double three-legged escapement for the famous Westminster clock, has been used in this case. This escapement is generally conceded to be the best for large clocks, as it allows a constant impulse to be given the pendulum rod regardless of the weights, which sometimes force the time on other forms of escapements. The train itself takes about 600 pounds of weight to run, and it is arranged to run eight days at one winding.

Fig. 2 shows the connection between the real clock and the hands, rigged up temporarily in the shop for testing the hands out of the window as in Fig. 5. The upright shaft of the Remontoire train drives the gearing above through the two universal joints, whenever the escapement is released by the master time clock at the right in Fig. 3. This drives the small crown wheel near the center of the frame and allows the long arm to pass through it every 30 seconds. When this long arm swings around until it again comes in contact with a tooth of the crown wheel, it operates the gearing which connects it to the large hands. Its movement is retarded by the two 6x9-inch fan blades shown, located at 11 inches from the center of the shaft.

The pendulum rod is a combination of steel and zinc in such proportions as will best counteract the most acute temperature changes and is 8 feet long, so as to beat 1½ seconds, weighing 76 pounds. The weight or bob is of cast iron with a rounding top to shed dirt as far as possible. This weights 330 pounds.

The hour wheel of the master clock is 10 5/6 inches in diameter and drives a pinion which caries a crown wheel of 15 teeth, which releases the Remontoire train every 30 seconds, so that the hand moves every half minute. Some idea of the bigness of the clock can be had when we figure out that the point of the minute hand moves 11½ inches every half minute. The main wheel of the Remontoire train

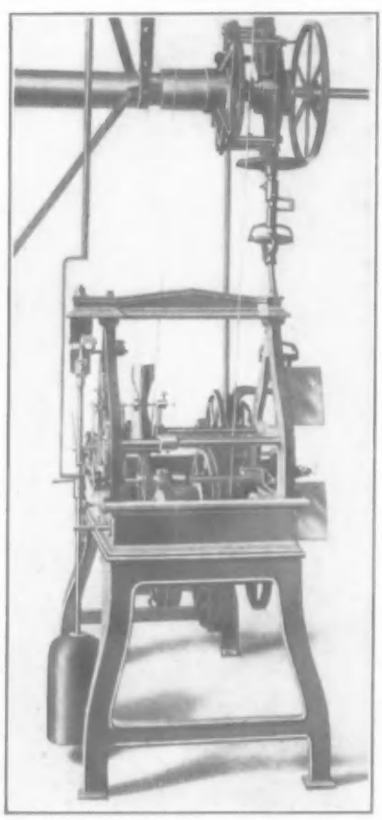


FIG. 2. HOW IT DRIVES THE CLOCK

is 30 2/5 inches in diameter, has 150 teeth and weighs 115 pounds. This train is driven by a steel rope ⅜ inch in diameter, which winds on a 17-inch drum and unwinds at the rate of 44 feet per day of 24 hours.

Some of the Details

The main wheel of the Remontoire train drives an upright shaft, as in Fig. 2, which connects by bevel gearing to the shafts driving the hands. The works at the center of the dial are shown in Fig. 6,

and weigh 830 pounds. The inner or minute-hand shaft is 2⅜ inches in diameter, while the outer or hour-hand shaft, which is hollow, as will be seen, is 3½ inches outside diameter. The horizontal shaft is supported by roller bearings 1⅜ inches in diameter and having conical ends so as to be self-centering. This is permissible in a slow-moving bearing of this kind, but would not be satisfactory on a high-speed bearing. The contacts for lighting currents are made by concentric rings around the hub of the hour hand which is inside, but a different plan had to be made for the minute hand. This is done by grooving the minute-hand shaft on each side for a wire and leading them to the two conducting rings shown around the shaft inside the housing. Carbon brushes make contact on the rings in both cases.

The Hands and How they are Made

Clock hands are usually a punch-press job, but such is hardly the case here where the minute hand is 20 feet long and 3 feet 6 inches in diameter at the hub, while the width of the spade, as the large part of the hand near the end is called, is 2 feet 11 inches. This hand is built up of sheet and angle brass of varying thicknesses from No. 15 to No. 21, and arranged as shown in Fig. 7. This must be calculated as a beam supported at one end and it is always necessary to allow for wind pressure at various angles, especially as an east wind will have a square shot at the whole surface of the hands. Then, too, the soldering of the sheet-copper covering over the whole thing must be a perfect job, as a leak that would admit water into the hand at any point would not only play havoc by freezing in winter, but would change the center of gravity of the hand with every position and make regulation almost out of the question.

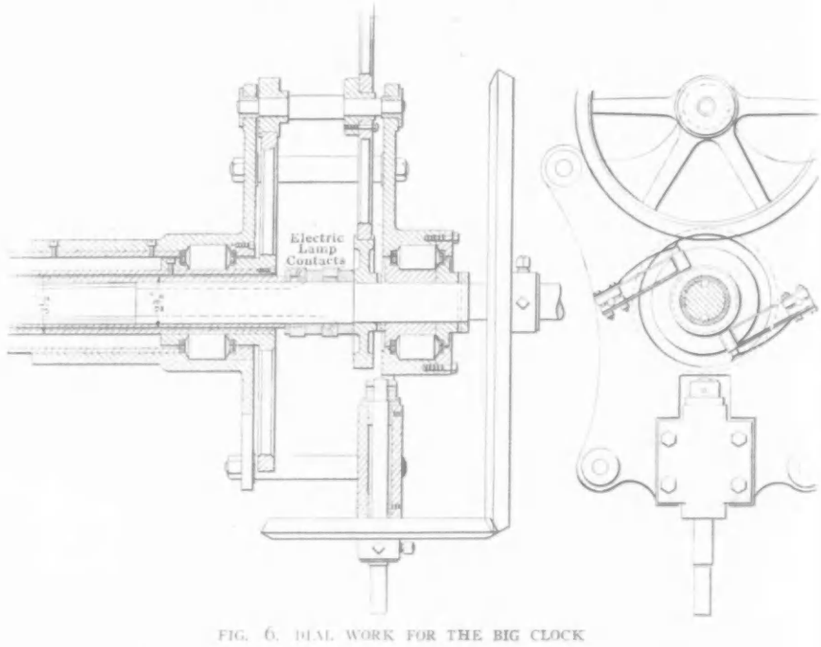


FIG. 6. DIAL WORK FOR THE BIG CLOCK

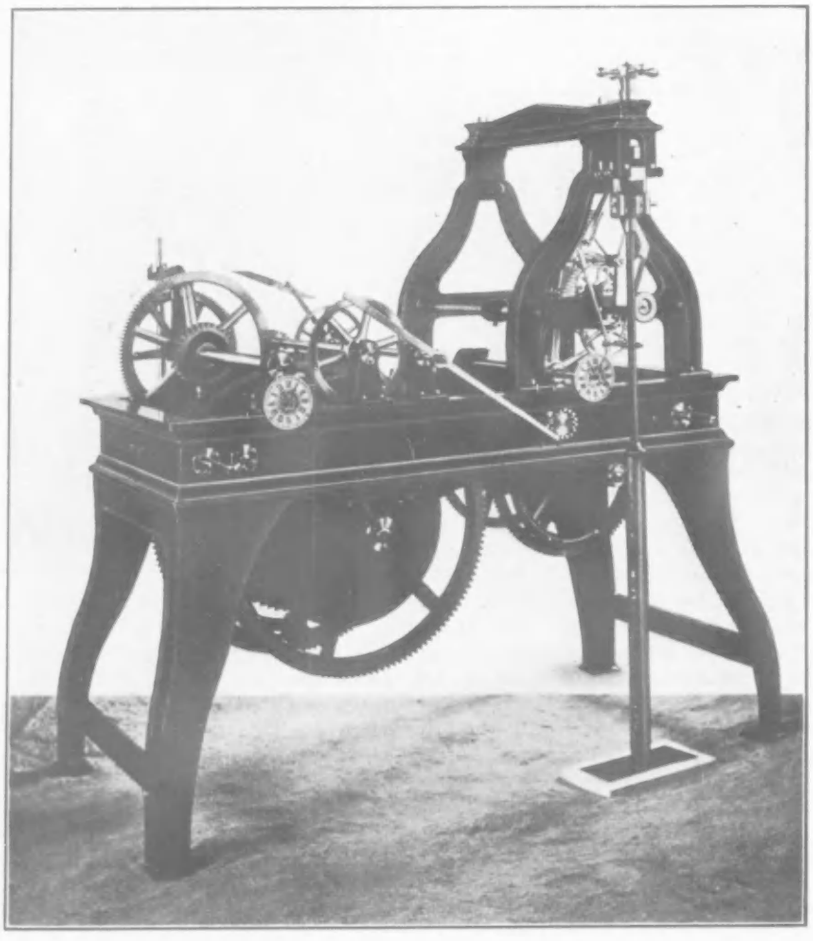


FIG. 3. SIDE VIEW SHOWING THE TWO MOVEMENT TRAINS

The balancing of these hands is an important problem, and has been very carefully done, the minute-hand balance weighing 270 pounds, and being 8 feet 6 inches from the center. The hand itself weighs 370 pounds, not counting the 37 pounds of "smalts" or black sand which painters use to give the velvety appearance which is so much more desirable than the dead plain black paint. The point of the minute hand travels 114 feet 8 inches an hour, or 2751 feet 10 inches, or over half a mile, every 24 hours.

The hour hand is 15 feet long, 4 feet in diameter at the hub and 3 feet 10 inches wide at the spade, and weighs, with its counterweight, 500 pounds. The point travels 6 feet 9½ inches an hour. While Fig. 5 shows both counterweights in front of the clock, this is not their correct position, and in service the minute-hand counterweight will be at the back of the clock. As the only place at the factory for testing the clock was out of the second-story window, there was no room for the counterweight except as shown.

The Dial and the Lighting

The dial, as before stated, is 40 feet 6 inches in diameter, and is built up of 6-inch pine boards against the same iron framework which carries the huge electric sign of Colgate. These boards are spaced 3 inches apart to lessen wind resistance, but the spaces will hardly be seen from the distance. There are no numbers, but the hour spaces are indicated by tapering

boards 5 feet 6 inches long by 30 inches wide at the outer end and tapering inward. These are approximately 10 feet apart so that every minute space is nearly 24 inches. The dial is painted white and the divisions black, so that they will show up very clearly even from a great distance. The hands are also black.

Both the divisions on the dial and the hands will be illuminated at night, the hour spaces being shown by a row of incandescent lamps which set in a trough so as to be below the surface of the dial. The hands are outlined with 4-candle-power lamps about a foot apart, there being 42 lamps on the minute hand and 27 on the hour hand. This great difference in lamps is because the hub of the hour hand is hidden by that of the minute hand.

The Seth Thomas Company has a large clock in its factory with a dial 17 feet in diameter and having hour marks 30 inches long by 4½ inches wide. None of these large clocks have numerals, and the minute divisions are omitted to avoid confusion. They are unnecessary in clocks of this size, as we can judge very closely by the position of the hands. In fact it doesn't take an expert to look at Fig. 5 and see that it is about 7 minutes of 2 in spite of there being no dial or anything but the bare hands to guide us.

I am indebted to the kindness of Mr. Gordon, of the Seth Thomas Company, who stands at the left of the minute hand in Fig. 4, and to Mr. Davey, the mechanical engineer of the Colgate company for the facts obtained. F. H. C.

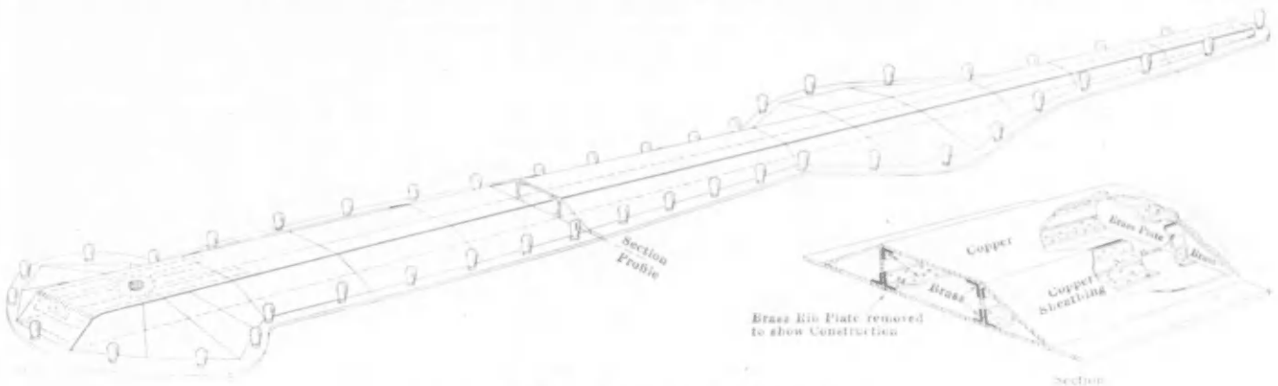


FIG. 7. DETAILS OF THE HAND CONSTRUCTION

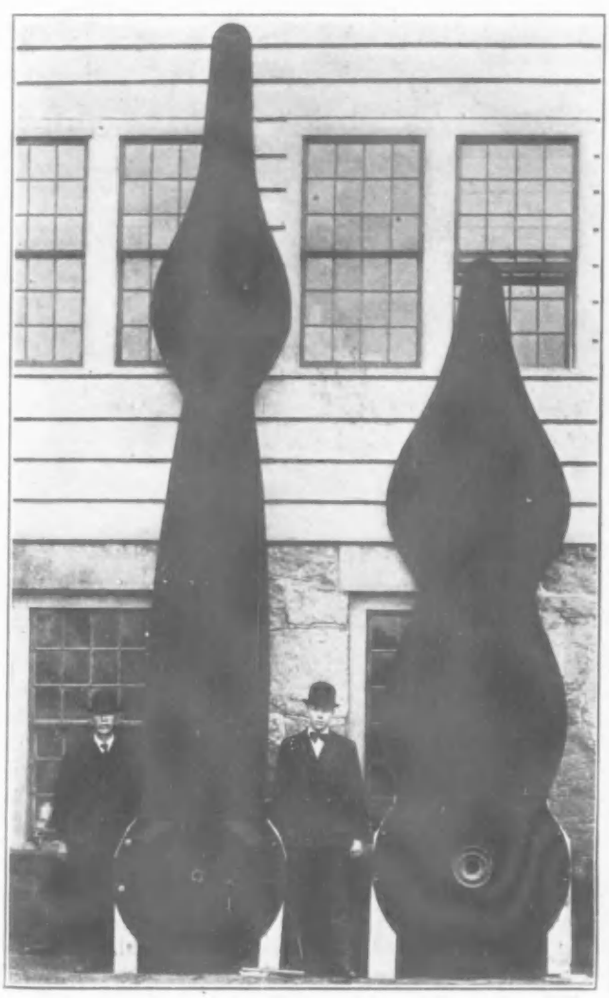


FIG. 4. THE HANDS AGAINST THE BUILDING

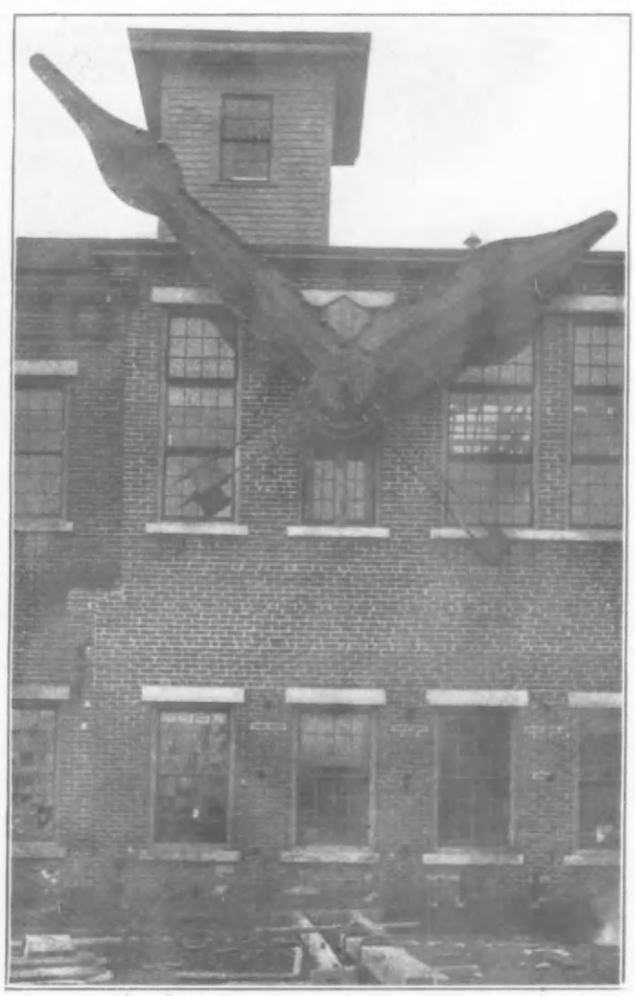


FIG. 5. TRYING THE MOVEMENT WITHOUT A DIAL

A Lapping Machine of Novel Construction

A Machine for Finishing Cylindrical Surfaces by Means of Reciprocating Laps Which Are Automatically Adjusted to the Work

SPECIAL CORRESPONDENCE

The accompanying engravings illustrate a lapping machine designed for finishing on the "clamp grinding" principle, plain journals, crank-shaft bearings, and other work with cylindrical surfaces. The general form of the machine is illustrated in Fig. 1. Its construction will be understood by referring to this half-tone and to the line drawings, Figs. 2, 3 and 4.

In this lapping machine as usually made for journals the laps are reciprocated by means of two crank-disks keyed to a shaft that rotates at right-angles to the headstock spindle, to which it is spirally geared in a ratio of four to one. Thus each lap makes one complete reciprocation, back and forth, over the journal it is polishing for four revolutions of the journal. Because the reciprocation is by crank-motion, there is a constant variation in the spirals traced out by any particle of the polishing material. The polishing material is supplied to a cavity formed in the upper half of the lap, which cup or cavity is closed by a threaded cap, so that the abrasive material will flow out gradually. The linings of the laps are arranged as in Fig. 4. Grooves or channels for the distribution of the polishing medium are formed in the upper half of the lap. Two guide pins fit in reamed holes, so that there can be no shifting of the two parts of the lap on each other, and two stop-screws limit the approach of the two parts, so that the pressure on the polishing or abrasive material ceases as soon as the stop screws come in contact with the lower half of the lap. As the pressure with which the polishing material is applied to the journal ought to vary with the fineness of that material springs are introduced under the pressure nuts, and by enlarging the pressure bolts below the washer that takes the thrust of the spring, the washer and spring cannot slip down too far to engage the cam-shaped surface of their bearing on the top half of the lap. Thus to separate the two halves of the lap, it is only necessary to swing the two pressure bolts outward, and correspondingly, to attach the two halves together, slip the upper half over the two guide-pins, and swing the pressure bolts inward to a vertical position. Fig. 4 shows these details fully.

The lower half of the lap is made with both a horizontal and a vertical projection at each end, which projections are machined on their sides to fit accurately into sockets or jaws in corresponding dogs or drivers. These latter as shown in Figs. 1 and 2 are clamped on two shafts which by means of connecting-rods are attached to the crank-pins on the crank-disks above referred to. These side-shafts are made of circular section of uniform diameter throughout their length, so that it may be possible to shift the laps to any desired position on the work, and for the same reason the brackets that carry the bearings for these shafts may be shifted

FIG. 1. LAPPING MACHINE

along the bed of the machine, so that there may be no interference with the motion of any particular lap. Because these side-shafts are of a uniform section throughout their length, it is possible to make use simultaneously of a number of laps in a variety of positions. Where several laps are used, the reciprocating motion may be limited by the width of the narrowest bearing, in which case the laps for wider bearings are made with longer linings. Clamp collars are used to locate each dog or driver, and prevent its shifting when turning down to disengage its lap.

The crank-pins in the disks are adjusted by means of screws, and then tightened in position. By means of a clutch on the crank-disk shaft the gearing connecting with the headstock spindle may be disconnected, to facilitate the rapid setting of the laps. While most work requiring lapping is not over a foot long, still certain pieces that can be lapped to advantage may be much longer. Piston-rods and plungers require a different machine, involving the use of a carriage and reciprocating mechanism similar to that of a grinder or planer. In another form of this machine the head is gear driven, the two-step driving cone receiving the belt being located at the end of the machine.

The laps must of course be held constantly in a plane at right-angles to the work being lapped, although free to move radially thereto to a limited extent: in other words, the laps must be allowed to "float." The work may be driven on centers by means of the ordinary lathe dogs, or the end near the headstock may be secured to the live-spindle by means of a socket clamp. In the process of lapping crank-pins, this is the preferable way, as the socket may be swung out from the center to allow for the exact throw of the crank. The same kind of socket-clamp may be attached to the foot-block spindle, in which case the latter must revolve.

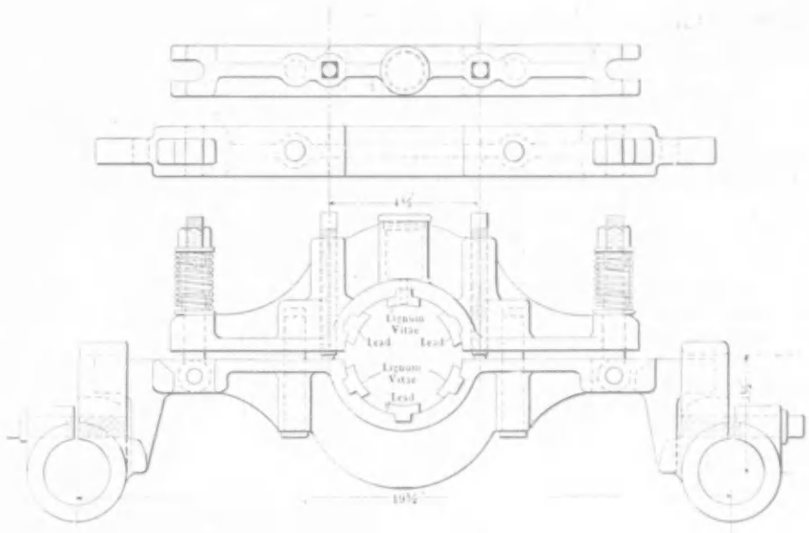


FIG. 4. CONSTRUCTION OF LAP

In truing up such work as gasolene engine crank-pins worn out of round from the hammering action of the explosion, the lapping machine will make a crank-pin of the maximum circular section possible, owing to the floating action of the laps.

The machine shown takes work 4 feet 6 inches long between centers and swings 23 inches over the bed. It is built by John L. Bogert, Flushing, Long Island, N. Y.

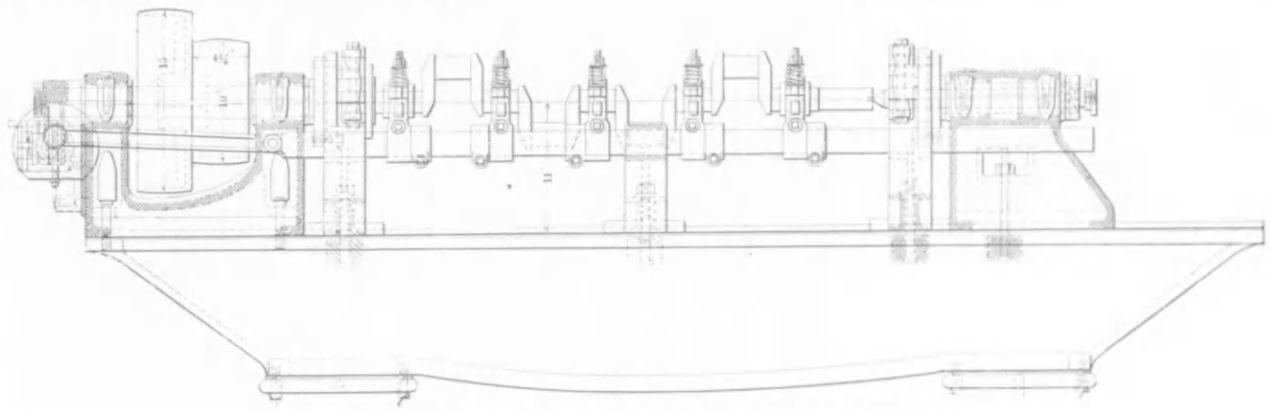


FIG. 2. LAPPING MACHINE ARRANGED FOR CRANK SHAFTS

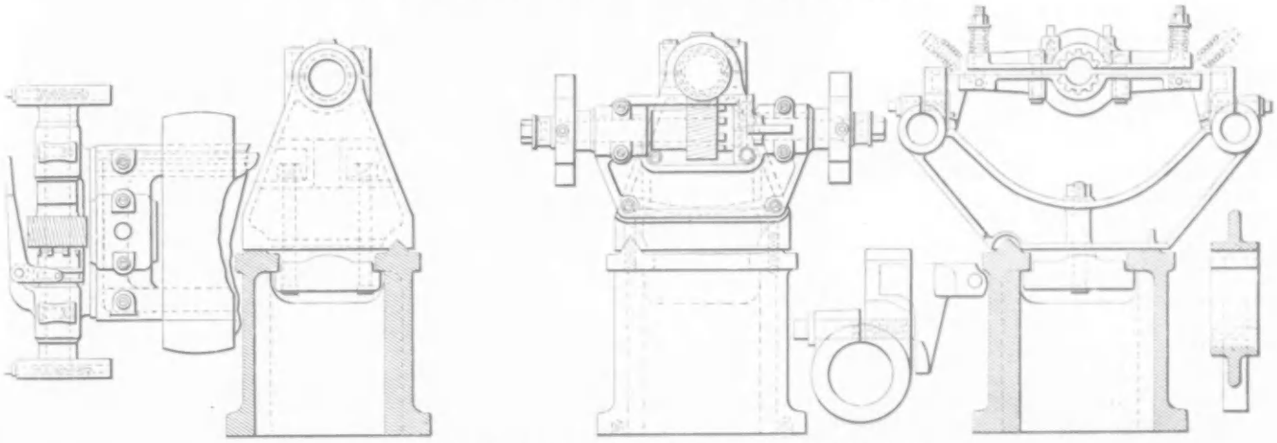


FIG. 3. END ELEVATIONS AND SECTIONS OF LAPPING MACHINE

Even Heating of the Electric Hardening Furnace

By G. B. Waterhouse

Some very interesting figures were presented at a recent students' meeting of the Institution of Civil Engineers in a paper on "Electric Hardening" and "Annealing Furnaces," by Paul T. Steinthal. They bring out clearly the control of operation and even heating that can be obtained with these furnaces.

The furnace on which the experiments were carried out consists of a bath of metal salts contained in a crucible molded in one piece. The crucible is covered with an asbestos lining, then with firebricks, and the whole inclosed in an iron case. Wrought-iron electrodes are placed on opposite sides of the bath, and connected to the secondary coils of a suitable transformer. The primary side is wound for some suitable voltage, and is tapped in order to obtain regulation of

Points.	Depth in Inches.		
	0.39	3.43	5.71
1	2020° Fah.	2048°	2053°
2	"	"	"
3	"	"	"
4	"	"	"
5	2028°	"	"
6	"	"	"
7	"	"	"
8	"	"	"
9	2026°	"	"

TABLE I

the current. A single-phase alternating current is used. Tests were carried out to prove that with the special electrodes

Depth Below Surface.	Temperature.
0.39"	2039° Fah.
0.59"	2075
0.79"	"
1.57"	"
3.43"	"
5.71"	"

TABLE II

a perfectly even temperature was obtained in the bath. Measurements were made with a thermo-couple, inclosed in an iron tube.

The bath, 6.3 inches square and 6.9 inches deep, was filled with pure barium chloride, and a pressure of 50 to 55 volts used. The furnace was heated up in about half an hour, and when the bath reached 1832 degrees Fahrenheit, the secondary voltage was dropped to between 13 and 18 volts. When the temperature of the bath was steady, the readings given in Table 1 were taken at nine points, in three different planes of the bath.

A further test was made by placing the tip of the pyrometer at six different points, below the middle point of the surface, with the results shown in Table 2.

These results show very clearly the homogeneous heating of the bath. Ordinary steel requires a temperature of 1562 degrees Fahrenheit, and this is obtained by using a bath of three parts by weight of pure barium chloride, and two parts of pure potassium chloride. For high-speed steels, however, which require a much higher temperature, varying from 2028 to 2126 degrees, a bath of pure barium chloride is used.

It has been found in practice that not only is the metal heated more evenly in an electrically heated bath than by older methods, but the whole process is much quicker. The salts used have no effect on the composition of the steel, but actually protect it from oxidation. On removing, a thin coating of the salt covers it, which is immediately removed when it is plunged into the cooling medium, so that the steel is well protected even when being transferred to the cooling tanks. If the steel is clean in the first place it retains a smooth metallic surface, silver gray in color, after being subjected to the hardening process.

The depreciation of such a furnace is small, the only part requiring renewal being the electrodes; and provided the bath is kept reasonably clean the salts can be used repeatedly. The furnace possesses undoubted advantages over the externally fired type, and is evidently a step in the right direction.

Some Interesting Broaches

Editorial Correspondence

At the shops of the Lanston Monotype Machine Company at Philadelphia, Penn., extensive use is made of broaches in the finishing of various parts entering into the construction of the type-casting machine made by this company. Some of the broaches and the work in which they are used are shown by the accompanying engravings.

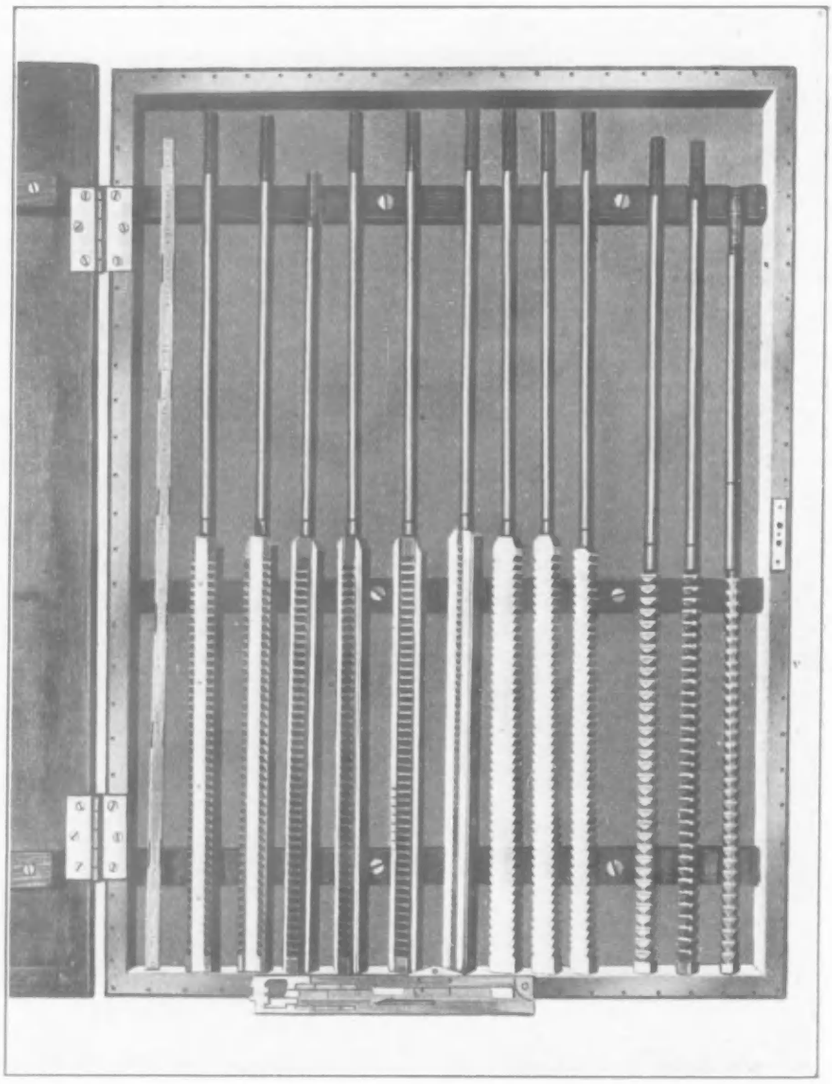


FIG. 1. BROACHES FOR MONOTYPE TYPE CARRIER

Fig. 1 illustrates a set of broaches for machining the opening in the end of a machine-steel part known as the type car-

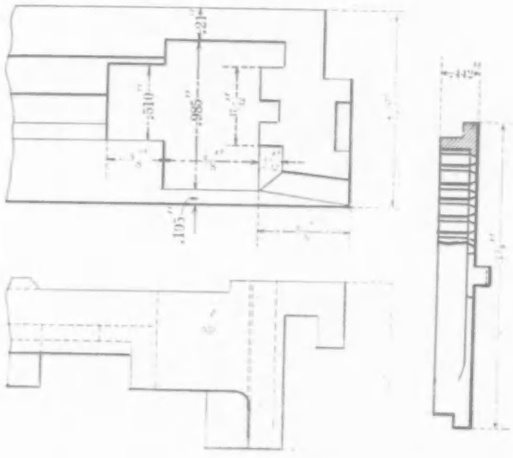


FIG. 2. OPENING IN END OF TYPE CARRIER

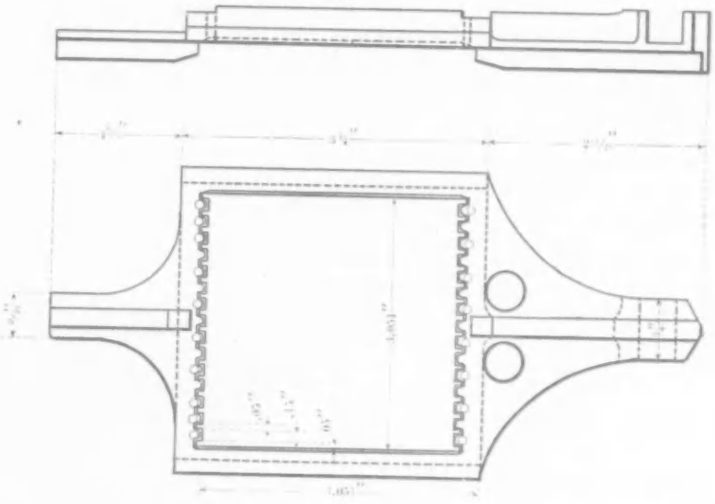


FIG. 4. MATRIX CASE

MATRIX CASE

rier. This piece is shown at the bottom of the box containing the broaches and the form of the opening and its general dimensions will be seen more clearly in the line cut Fig. 2. At the outset a hole is drilled through the steel block to admit the first broach, shown at the right-hand side of the case. This broach expands the original hole and starts the squaring up of the hole by forming flats on four sides. The second broach shown immediately to the left removes the greater part of the arcs and the third broach produces a sharp corner and the general rectangular form of the opening. The broaches used in the successive operations are arranged from right to left and the reader will be able to see at once just which portions of the opening each broach assists in producing.

It will be seen that the work is pretty well divided among the series of broaches, some of them being arranged with a central row of teeth for cutting the middle slot while others have broaching sections at the sides for the remaining slots. The broaches measure over all about 30 inches and are used in a J. T. Burr machine, operating on the draw-cut principle. The broaching sections themselves are approximately 15 inches in length.

Fig. 3 illustrates a pair of broaches for finishing the interior of the matrix case referred to in previous articles on the monotype shops. The form of this case is illustrated in Fig. 4 and three cases are shown in the background of Fig. 3 illustrating the appearance before and after broaching.

The matrix case is a malleable-iron casting and the square opening is cut out approximately to size in a special indexing fixture used on the milling machine, a pair of side mills operating simultaneously on opposite sides of the case. Upon the fixture being indexed 90 degrees the two other sides of the opening are milled. This operation, of course, leaves some little stock in each corner which must be re-

moved and in addition to the squaring out of the opening, the series of slots along opposite walls have to be cut. These slots carry the wires on which are placed the matrices against which are cast the type. The broach to the left in Fig. 3 is about 4 feet long. It cuts out the corners of the opening in the case and the shorter broach produces the narrow slots seen in the detailed drawing. Both of these broaches are of course built up, the broaching blades being inserted in bodies of suitable form. They are used in the same machine as the type-carrier tools just referred to. F. A. S.

Interesting Machines from Germany

The planers shown herewith are motor driven, the motor in Fig. 1 being located in the box at the back end of the bed. This has a capacity of 28 inches in hight, 32 inches wide, and will plane 6 feet long. As will be noted, both of the ways are flat, and the table is provided with a channel around the edge so that lubricant can be used freely on the cutting tool, being brought down through the flexible tube from the cross tie between the uprights. Provision is made for the lubricant to be returned from the table to a reservoir in the bed, and from here it is pumped to the flexible tube shown.

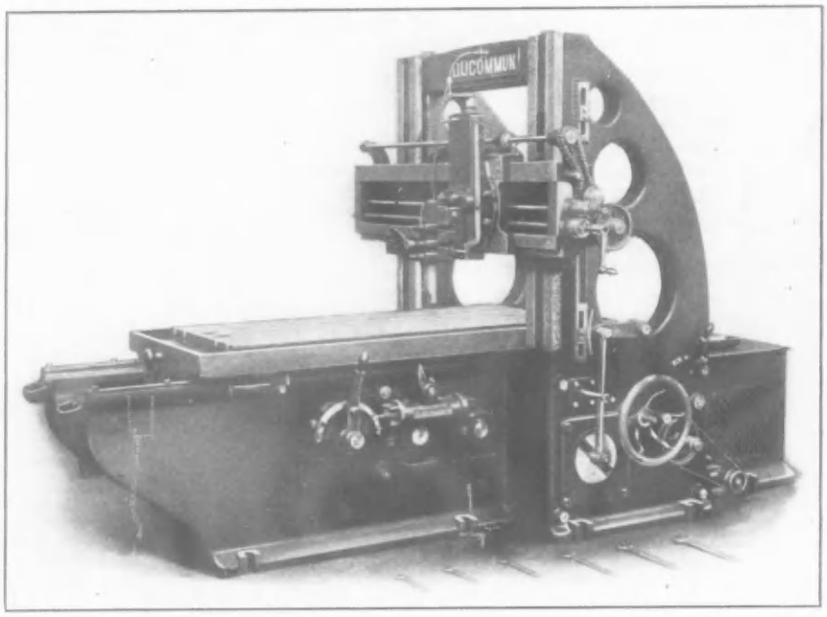


FIG. 1. SMALL GERMAN PLANER

Particular attention is paid to accurate reversal of the table, so that work can be planed to an exact line whenever necessary. Three cutting speeds are provided, but the return speed is constant in all

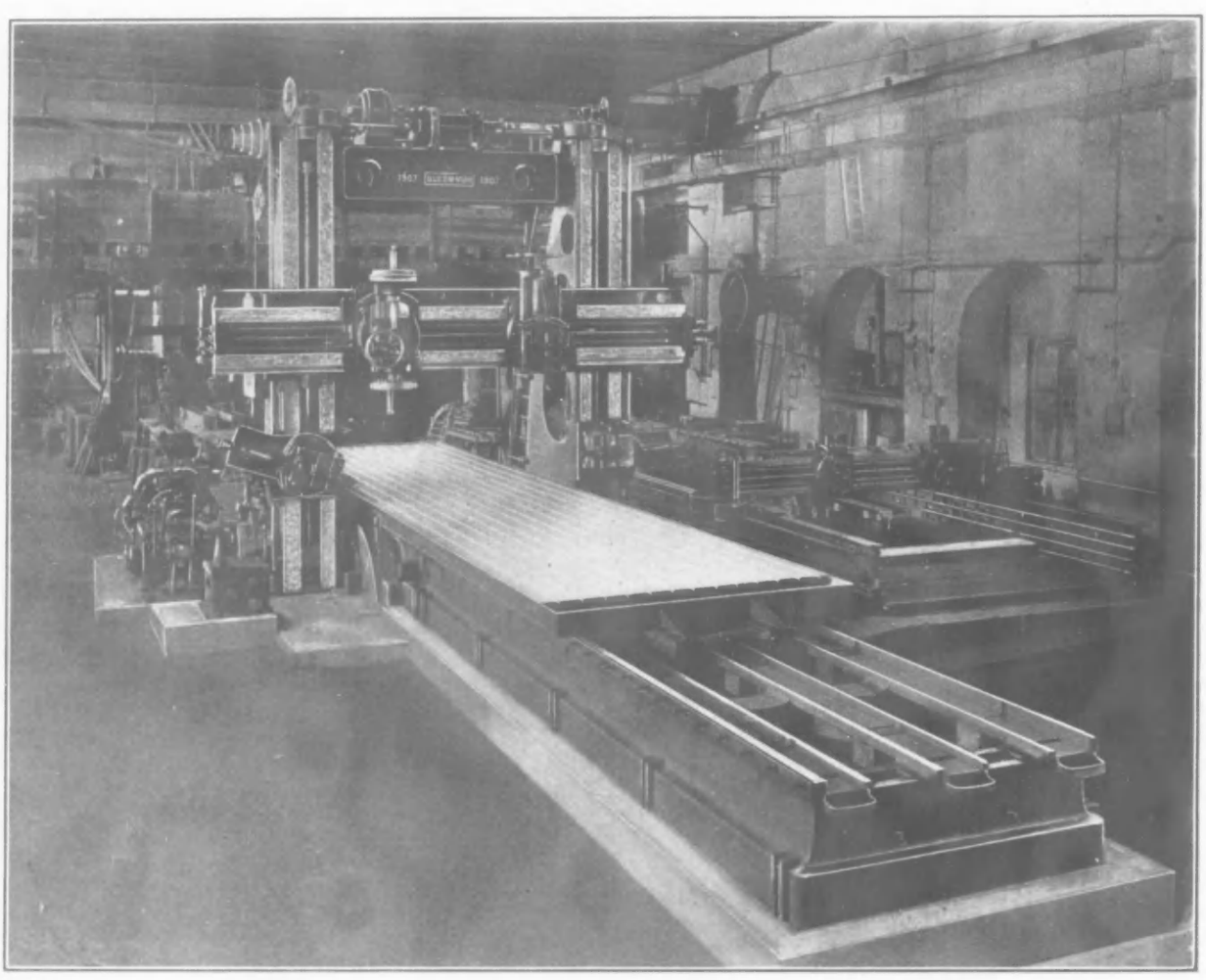


FIG. 2. TWO LARGE PLANERS

cases. The table can be controlled from either side of the machine and special provision is made for lessening shock when the table is reversed. The cross-rail has power feed in both directions, and the tool slide can also be fed by power, even when it is inclined up to 45 degrees in either direction. The tool is clamped at three points by three separate tool posts, posts are independent and of three different varieties, as shown. A back rest is provided of a very substantial design and is equipped with a hardened steel shoe which just fits the work. The tailstock has a nose which projects considerably longer than in most of our designs, but is probably to accommodate the special work for which it was designed. The spindle

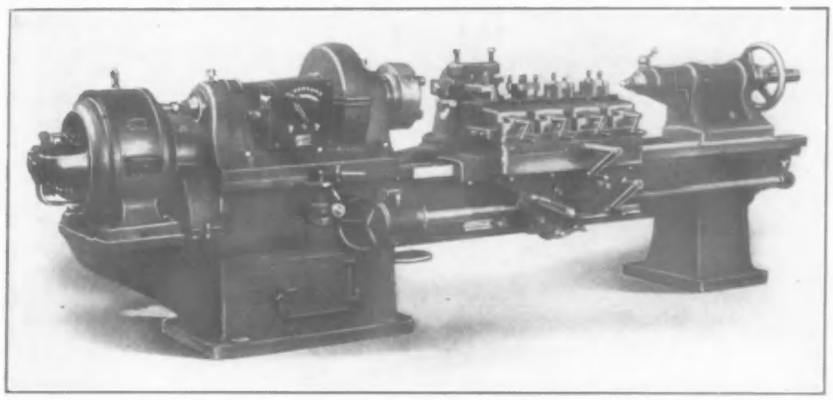


FIG. 3. SPECIAL LATHE FOR CAR BUFFERS

and is automatically lifted on the return stroke by the arrangement shown.

Fig. 2 shows a large planer by the same maker, which has a table 30 feet long, with the other capacities in proportion. This also has flat ways, three in number, and two driving racks, as in the case of the large Bement planer illustrated early in the year. These planers are quite often equipped with milling heads, one of which is shown in this case. It has eight planing speeds and six milling feeds, all of which are obtained by the feed box, to which the large 50 horse-power driving motor is connected on the foundation at the left of the machine. The raising and lowering of the cross-rails is controlled by an independent 14-horse-power motor, shown on top, making it a modern tool in every way.

To the right of the big planer is a large traveling-head planing machine located over a pit, which will take in 13 feet 6 inches in width, 20½ feet in hight, and plane work 40 feet long. It is at work on a good sized planer bed, and can handle almost any piece of work that is likely to come along. The cross-rail carries two heads on each side, and planes in both directions. These are built by the Werkstatte fur Maschinenbau, Vormals Ducommun, Mulhausen (Elsass), Germany.

A Rapid Reduction Lathe

Fig. 3 shows a special lathe built by the Maschinenfabrik Lorenz, Ettlinger, Bothen, Germany, particularly for railroad work, such as turning buffers of the kind used in Europe. It has a geared head, with all gears inclosed, from the motor pinion to the spindle gear. In this case four tool slides are provided, but this varies from three to five, according to the purpose for which the machine is to be used. The tool is drawn through the hand-wheel, which acts as the nut in this case. Both ways are flat. The carriage feed is all geared, and taken all together it presents a very substantial looking machine for the rapid reduction of stock, although it is not clear how it works to advantage on short work of the kind named, owing to the length of the carriage and the space occupied by the tools.

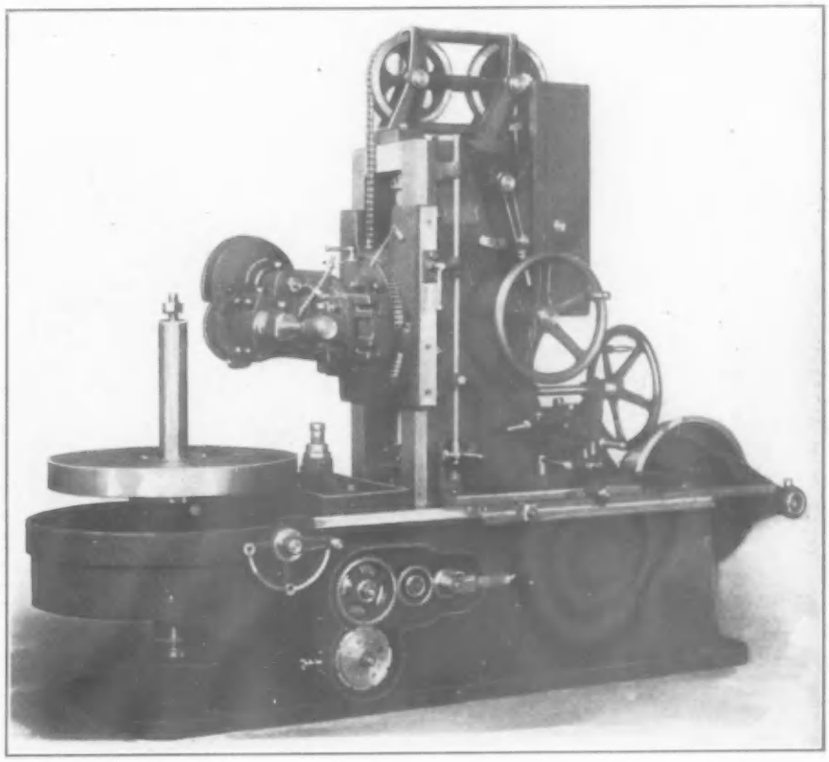


FIG. 4. LARGE GEAR HOBBING MACHINE

Geared Hobbing Machine

Fig. 4 shows one of the heavy geared hobbing machines which have been developed abroad, and can be used for either plain spur-gear cutting with formed cutters, or with the hobbing cutter, as may be desired. It is of the type of machine in which the hob moves past the face of the work as it revolves, and is entirely automatic when used in this way.

When cutting spur or spiral gears with the formed cutter, it is run as a semi-automatic machine, or the indexing can be done by hand on special work should occasion demand. These machines are listed to cut gears up to 16 feet 8 inches in diameter.

Russia is the latest country to take up commercial motor vehicles to any considerable extent. May 24 the Moscow branch of the Russian Motor Club will hold a commercial vehicle competition over the Moscow-St. Petersburg road. Vehicles will be arranged in three classes, namely, class 1, for automobiles carrying a load of over 2½ tons; class 2, for cars carrying a load of between 1½ and 2½ tons, and class 3, for cars carrying loads of under 1½ tons. From the maximum useful loads set forth in the maker's catalog a deduction of 6½ cwt. will be made for body work. There is no speed limit for the third class, but the maximum speed for the first two classes is 10 miles per hour, and neither of these classes, by the way, may be shod with pneumatic or iron tires. Included in the trial is a hill-climbing test, in which the driver has to stop halfway up the hill and restart within the minute.

The Handling of Stock-in-Process and Finished Stock

By A. J. Doughty*

The handling of stock-in-process and finished stock should be entirely in the hands of a distinct department, working at all times in close conjunction with the cost department; for the more systematically stock is carried through the various operations the nearer will an accurate cost be obtained.

This article gives a synopsis of the system in use in the factory of the Burroughs Adding Machine Company, Detroit, Michigan. It has proved to be successful in keeping in close touch with the stock, and is devoid of all unnecessary "red tape."

All stock is handled in tote boxes which are numbered and which have the weight of each box stamped on the side. Factory form 210, Fig. 1, is made out for each straight symbol number manufactured. These cards give the name of the part, the operations through which it passes, the description of the raw material, the number of pieces which can be made from a bar of stock, and the number of pieces which can be placed in a box, as well as a detailed record of each order issued, showing the number of pieces reaching the finished-stock room and amount of raw stock used.

*Factory manager, the Burroughs Adding Machine Company.

Whenever an order is issued for any certain symbol number the information on this card is used to start it through the factory.

A box card and sheet (forms 246 and 247), Fig. 2, are then made out for the required number of boxes. These cards show the amount ordered, the number of pieces per box, the date they were ordered and the date wanted, also the number of boxes required for the order. Under heads of "Department" and "Operations" are registered the successive stages of manufacture. The box card accompanies the work through the factory, while the sheet remains in the stock-order office for record. These cards are issued from the stock-order office, and where necessary, a duplicator is used to advantage.

BURROUGHS ADDING MACHINE CO.

NOTIFICATION TICKET

ORIGINAL

DATE 12/21 1907

TO DEPARTMENT 15

THE FOLLOWING STOCK IS NOW READY FOR YOUR DEPARTMENT

FOR FURTHER OPERATIONS

SYMBOL & LOT NUMBER	OPERATION	QUANTITY	BOX NUMBER
630A	15	2500	4563
	15	2517	6972

ISSUED BY DEPARTMENT 4

FOREMAN Murray

FIG. 4. FORM 244, A NOTIFICATION TICKET

Accompanying these box cards to the department doing the first operation is a stock order (form 215), Fig. 3, issued in duplicate. The duplicate is sent to the raw-stock room. With the signed original the foreman draws upon the raw-stock room for the material to start work upon that particular piece. That department, in turn, enters upon the back of both original and duplicate the date and amount of stock delivered, retains the original for their own files and returns the duplicate to the stock-order office for entry upon the record cards or form 210. Stock is ordered from the raw-stock room by the foot, but goes out by weight.

After completion of the first department's operations the pieces are weighed by that department and charged out to the next department, whose foreman receives at the same time an original notification ticket (form 244), Fig. 4. The duplicate of this is sent to the clearance-house branch of the stock-order office for entry upon the record sheets (form 247), thus serving to locate immediately any piece of stock in the factory.

This plan is repeated until all the operations on the box card have been completed and the pieces reach the final-inspection department. Here the cards are stamped "Finished" and replaced in the box and the parts are delivered to the finished-stock room. No stock is received in the finished-stock room unless it has passed through the

BURROUGHS ADDING MACHINE COMPANY. STRAIGHT SYMBOL ORDER RECORD SYMBOL NO. 630A

Name of Part Hub for 62214 Operations (1) 3272 (2) for 6908 15 (HW) 10 Hole (3) 380

Description of Raw Material 5/8 Gun Rod

Amt. of Mat'l for 100 Parts in Ft. Weight Bars 7 Ft. Long 12 Pieces 279 No. Per Box 2500

FIG. 1. FORM 210, STRAIGHT SYMBOL ORDER RECORD

BURROUGHS ADDING MACHINE CO. ALL STYLES

SYMBOL & LOT NO. 630A 3 BOX NO. 4563

NAME OF PART Hub for 62214

NUMBER ORDERED 5000 DATE ORDERED DEC. 19 1907 DATE DUE FEB. 15 1908

NUMBER PER BOX 2500 NUMBER OF PIECES 1/2

DEPT.	OPERATIONS	DATE	QUANTITY OF STOCK TAKEN FROM STOCK	NO. OF PIECES	BOX No.	PIECE RAN O.K.	QUANTITY SENT AHEAD
4	(1) 3272 (2) 6908						
15	15						
1W	10 Hole						
12	380						

BURROUGHS ADDING MACHINE CO. ALL STYLES

SYMBOL & LOT NO. 630A — 3 BOX NO. 4563

NAME OF PART Hub for 62214

NUMBER ORDERED 5000 DATE ORDERED DEC. 19 1907 DATE DUE FEB. 15 1908 DATE RECEIVED

NUMBER PER BOX 2500 NUMBER OF PIECES 1/2 ENT. IN CARDS ENT. STOCK OFFICE

DEPT.	OPERATIONS	DATE	QUANTITY DELIVERED	TOTAL COST	SENT AHEAD QUANTITY	DATE	BOX NO.
4	(1) 3272 (2) 6908						
15	15						
1W	10 Hole						
12	380						

FIG. 2

FORM 246, A BOX CARD FORM 247, A BOX SHEET

SYMBOL AND LOT NO. 630A—3

BURROUGHS ADDING MACHINE COMPANY, RAW STOCK ORDER

DATE 12/19/07

PLEASE DELIVER TO DEPARTMENT 4 THE FOLLOWING MATERIAL

5/8 Gun Rod

228 ft

NOTE—PLACE DATES AND AMOUNTS OF MATERIAL DELIVERED ON BACK OF TICKET

NO. PARTS WANTED	NO. PIECES PER BOX	WHEN WANTED
5000	2500	2/15/08

STOCK OFFICE PER Wright | DELIVERED BY JG | FOREMAN Murray

ORIGINAL

DATE	MATERIALS	QUANTITY	COST	AMOUNT
12/19/08	120'	225		619
1/20	96'	13		
1/24	12'	238		260

DUPLICATE

FIG. 3. FORM 215, A RAW STOCK ORDER

inspection department and has been stamped "Finished" by that department. After it is received in the finished-stock room it is put in a place reserved for that particular symbol number. In this way all stock of one kind is kept together. The amount is entered on the invoice card (form 290), Fig. 5. This card shows the date on which the stock was received or delivered, and gives at all times a perpetual inventory of finished parts.

In the stock-order office two cards very similar to form 290 (forms 267 and 268), Fig. 6, are kept for convenience. This gives one place where all of the stock, both in the finished-stock room and in-process, can be checked up, thus avoiding the necessity of going from one department to another to get a line on the amount of stock of any one symbol number in the factory.

"Dash stock" (meaning stock which has been assembled) is taken care of on form 267. This card shows what each dash consists of and the number of pieces used, also into what dash it is to be assembled next and for what style machine; otherwise the information is the same as on the straight cards.

All operations are numbered, which is a short and quick way of handling them. About once a month all straight and assembled stock, both finished and in-process, is checked up and totaled. The totals determine how many sections can be built, and what parts are low and need ordering. This is done by the use of construction sheets which show what parts go together to make up the different sections.

The foremen of the different departments are kept in touch with the parts most needed by the use of a rush list issued each morning from the stock-order office, showing the symbol number needed and the department in which it is located. For each of the different sections a stock tracer is employed, whose duty it is to keep stock moving through the factory; his dealings are entirely with the foremen of the departments.

It is obvious that the workmen throughout the factory are in no way hindered in getting out a full day's work by having to fill out useless forms or tickets; all of this work is taken care of by the foremen of the different departments and by clerks.

Some Vicissitudes of the Job Shop

By J. G. Dornbirer

One day a newspaper man came in and told the boss that he had invented a machine for pasting the wrapper around his paper; it was a small and cheap machine, suitable for, and within reach of, every small newspaper publisher. But, since the Patent Office required a descriptive drawing of a working machine, he would like to have the boss build him one. Now this man had made money in his little office. He was the head molder of public opinion in his county, and since his party required more services than the other and was in power, and having no competition, he was in a fair position to maintain prices, at which some thought shamefully exorbitant figures.

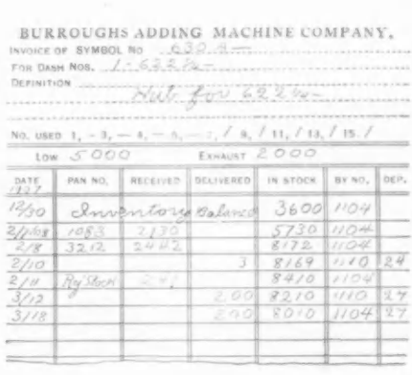
He was one of that class who think that it requires an enormous amount of brains to get a patent. He just made motions with his arms and fingers to indicate the approximate motions required to wrap and paste a wrapper around a paper. "Now," he said, "go ahead and make a machine, and whenever you are up against it, let me know." Then he hurried back to his bin.

Of course, you can readily see that there are two very plausible interpretations to his last statement, and maybe more. But only two are necessary in this article. The boss thought he must have meant either being mechanically "up against it," or financially "up against it," so he chose the latter as the proper interpretation. The mechanical interpretation was not entertained, since the boss thought that he was O. K. in that respect.

Well, the boss started in by spending one week thinking, then sent in an invoice for $30. The next week he made drawings, and a frame with a certain number of bearings and bosses judiciously distributed thereon. It required about $50 to liquidate these services. The next week he applied a few gears and pulleys with quite an abundance of thought; this required more of the liquidating medium. Then the boss began to realize that he would have to be the inventor. So he sent for the editor and explained matters, strongly protesting that he had no desire to become an inventor; it required too much of his time, with no results. But the editor was hardened to such business calamities; he frequently had some of his goods returned, so he patted the boss on the back and told him to go ahead, "he was doing well," and cheerfully paid the bill and departed.

This experience gave the boss the first idea that time was money, and that it necessarily need not be accompanied by manual effort, so long as the purchaser of that form of goods was satisfied. He knew his goods were rotten, but since there was a demand for them, why not furnish more? He soon discovered that as he became more familiar with the manufacture of the aforesaid goods, his goods improved. Where he formerly yanked the thing from under the bench, where he would shove it in disgust, he now withdrew it more gently, and with considerable less disgust. He also began to see that what once he thought was a judicious distribution of bearings and bosses began to appear more like promiscuous distribution; in fact, he began to have a mania for the thing.

The first stages of the wrapping process were solved; the bills were paid fairly promptly, which was no small incentive to further effort. But the editor began to complain that for the money he was paying, the showing was decreasing. So it was. But the boss was arriving at a point where progress was becoming slow. He had to resort to study on various mechanical subjects to get in line with motions not generally known. It took lots of time, and he began to see that the mechanical field was no 2x4 city lot. He began to study and read on mechanical subjects from every up-to-date source.


BURROUGHS ADDING MACHINE COMPANY.

INVOICE OF SYMBOL NO 630 A

FOR DASH NOS. 1-622 1/4

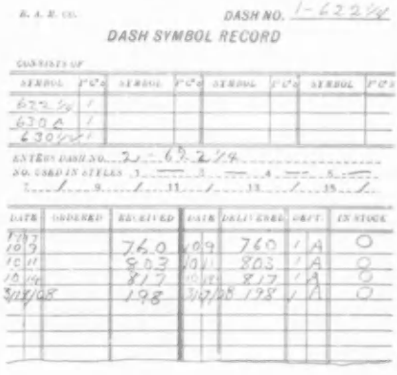
DEFINITION Hitch for 622 1/4

NO. USED 1, — 3, — 5, — 7, 1 9, 1 11, 1 13, 1 15, 1

LOW 5000 EXHAUST 2000

DATE 1907	PAN NO.	RECEIVED	DELIVERED	IN STOCK	BY NO.	DEP.
12/30	Inventory Balance			3600	1104	
2/08	1083	2130		5730	1104	
2/8	32.12	2442		8172	1104	
2/10			3	8169	1110	24
2/11	Ry Stock	241		8410	1104	
3/12			200	8210	1110	27
3/18			200	8010	1104	27

FIG. 5
FORM 290, AN INVOICE CARD


B. A. M. CO. DASH NO. 1-622 1/4

DASH SYMBOL RECORD

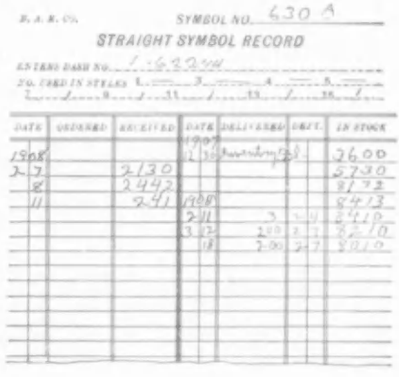
CONSISTS OF

SYMBOL	PCS	SYMBOL	PCS	SYMBOL	PCS	SYMBOL	PCS
622 1/4	1						
630 A	1						
630 1/2 A	1						

ENTERS DASH NO. 2-622 1/4

NO. USED IN STYLES 1 — 3 — 4 — 5 —
7 — 9 — 11 — 13 — 15 —

DATE	ORDERED	RECEIVED	DATE	DELIVERED	DEPT.	IN STOCK
1907						
10/3		760	10/9	760	1 A	0
10/11		803	10/11	803	1 A	0
10/14		817	10/15	817	1 A	0
3/20/08		198	3/20/08	198	1 A	0


B. A. M. CO. SYMBOL NO. 630 A

STRAIGHT SYMBOL RECORD

ENTERS DASH NO. 1-622 1/4

NO. USED IN STYLES 1 — 3 — 4 — 5 —
7 — 9 — 11 — 13 — 15 —

DATE 1907	ORDERED	RECEIVED	DATE	DELIVERED	DEPT.	IN STOCK
12/30			12/30	Inventory Bal.		3600
2/7		2130				5730
8		2442				8172
11		241	2/10			8413
			2/11		3	8410
			3/12		200	8210
			18		200	8010

FIG. 6
FORM 267, DASH SYMBOL RECORD — FORM 268, STRAIGHT SYMBOL RECORD

He also began to see that only a very small portion of the time consumed could be charged conscientiously to the editor. The further on he got the more he felt that he should have charged less in the beginning; he realized that he was fast approaching the point where he contemplated refunding some of the money already paid by the editor. But at this point he stopped, thanks to his strong will power; for one step further and he would have landed in a pulpit.

But, say, doesn't it prove how conscience condemns ignorance, especially where there is no excuse for it?

Well, the machine began to develop, much to the satisfaction of the editor. The boss began to see that he was delivering a very high grade of goods at a very mediocre stipend. But he greatly lacked in ingenuity as to the proper course to pursue. The editor was beginning to see less for his money every time he came, never dreaming of the amount of ability required to work out every innocent looking part, that looked very simple now that it was made. It became a real problem to get the proper pay for his now valuable services.

He also saw that he was the real inventor, and not the man who made the motions with his arms and fingers the first day he came into the shop. This man from that moment on furnished no further ideas. This editor might have swung his arms about his head to convey the idea of a flying machine, the boss might have succeeded in making a successful one. The editor would have patented it, and the boss for his share might have received $\frac{0}{0}$ (any old thing). Well, when this machine was complete the editor set it up in his office and invited the public to come in to see it. The papers cracked him up as the successor of Thos. A. Edison; a prouder cock never entered a pit.

Now to apply for a patent. Of course, he had to swear that he was the inventor. The only patent attorney in town was a chum of the boss, and they had an understanding about the invention. The boss felt more or less as though he had not received his share, so when the editor was asked to swear that he was the inventor he halted (the patent attorney laid considerable stress on this part of the ceremony); he could not do it. The attorney suggested a way out of it, which suggestion brought the editor and the boss together. The boss got a satisfactory sum and in return signed over everything to the editor. The editor obtained a patent. But as it never came on the market, we presume the editor pigeon-holed it by mistake; he was a member of the town council and got in that habit from the numerous petitions presented to him.

That Fish Oil Smell

By Ethan Viall

Anyone who has ever used fish oil for cooling steel, knows that limburger cheese is a bunch of roses beside it, especially if the oil has been used for some time.

A few weeks ago D. G. Clark, of the Firth-Sterling Steel Company, was showing me through their "Blue Chip" hardening plant in Chicago, and when we came to the big oil tank I noticed the almost total absence of the "fish-oil" smell, and, therefore, promptly asked him what oil he was using. "Fish oil," said he, and then noting my incredulous look added, "and a little standard tempering oil."

He went on to explain that some time previous they had accidently gotten some heavy oil in their bath, and as it apparently did no harm, they paid no further attention to it, until the hardener discovered that most of the fish-oil smell was missing, and as it was a thing they were glad to lose, they did a little experimenting with the result that they now add about three gallons of what is known as standard tempering oil to each 100 gallons of fish oil in the tank. This apparently has no other effect than to practically eliminate the dreadful "fishy" smell.

It is interesting to note that they do not use either a water jacket or water pipes to cool their oil, but use a tank of ample size, which is air cooled, the air being forced up through the oil from a sort of crow-foot arrangement of pipes at the bottom of the tank. This arrangement has been in use for some time, and is entirely satisfactory in every respect.

The Pond Rigid Turret Lathe and Some of Its Work

Since this lathe was first illustrated in our columns, on page 289, Vol. 26, it has been taken over by the Niles-Bement-Pond Company, and is being built at their Pond works in Plainfield, where a number of new features have been added and improvements made. It is a much more powerful machine than before, being now equipped with double back gears and supplied with a large two-step cone or arranged for motor drive as desired.

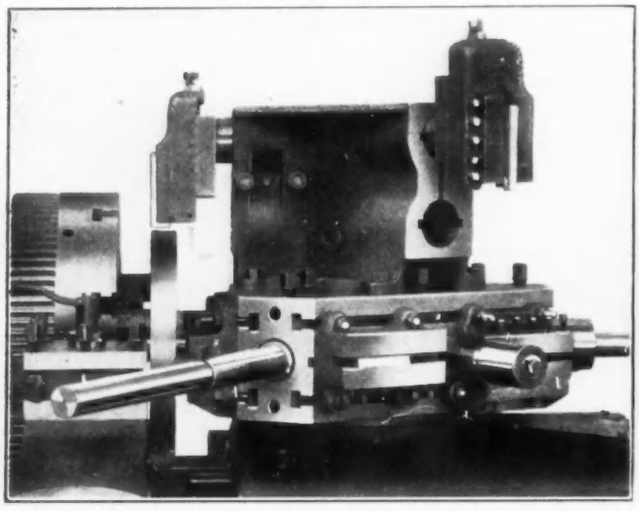


FIG. 1. THE EXTENSION TURRET

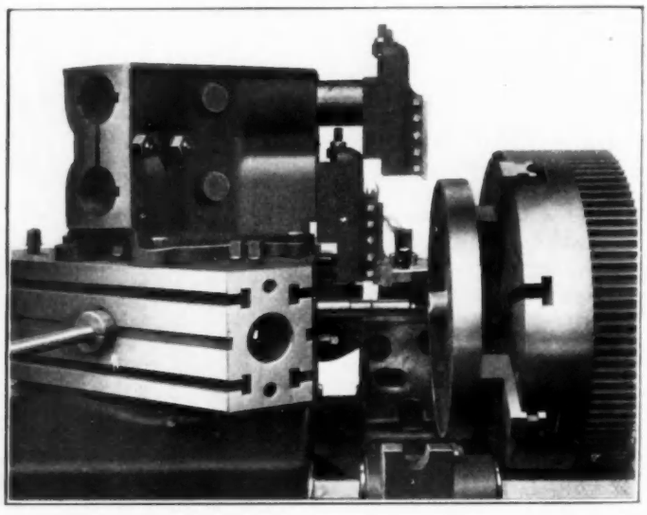


FIG. 2. TWO TURNING TOOLS IN EXTENSION TURRETS

The machine is now supplied with an upper or extension turret which enables turning tools to be held advantageously and largely increases the range of work that can be done. This extension turret has two sets of holes, which are connected by a slot, and this slot enables tools in either hole to be clamped by the one set of bolts which are located between them. The shanks of tools which fit into these holes have a key which fits either of the keyways shown according to the position in which it is inserted. This enables the turning tool slide to be set for quite a range of diameters without increasing the overhang to any considerable extent by simply turning the body of the tool so

that its projecting slide shall be up or down, as seen in Fig. 1. Fig. 2 shows how closely two of these turning tools can be grouped together; in this case the lower one is set for turning the outside of the hub and the upper one for turning the outside of the fly-wheel, both being done while the hub is being faced, the work being steadied by the arbor in the hole.

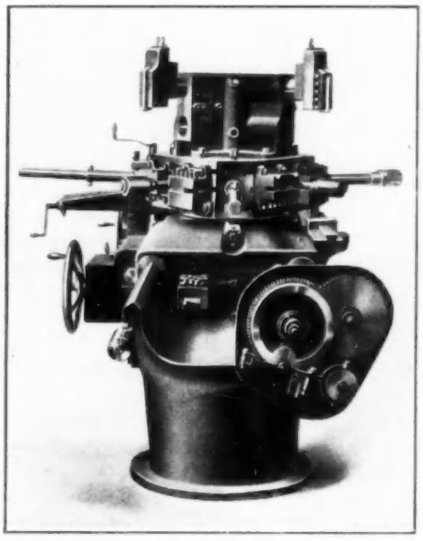


FIG. 3. TURRET TURNING MECHANISM

Fig. 3 shows the end of the lathe with the gear case removed to show the mechanism for revolving the turret by power after it has been fed back so that the tools clear the work as it revolves. When the turret reaches this point it strikes a rod connected with the left-hand end of the forked lever and pushes it toward the observer. This lifts the indexing pin out of the radial slot in the gear wheel and at the same time throws the clutch controlled by the forked end of the lever so that the gear train shown is connected with the shaft at the back, and the turret commences to turn. When it has turned one space, the indexing slot is again under the pin which drops into it and automatically throws out the clutch, the carriage is fed forward and the operation is not repeated until it returns for the next indexing. When the operator desires to skip one or more holes in the turret he does not move the carriage forward until the turret passes the last hole he wants to skip, for the turret will turn as long as the carriage slide is against the rod that controls the clutch.

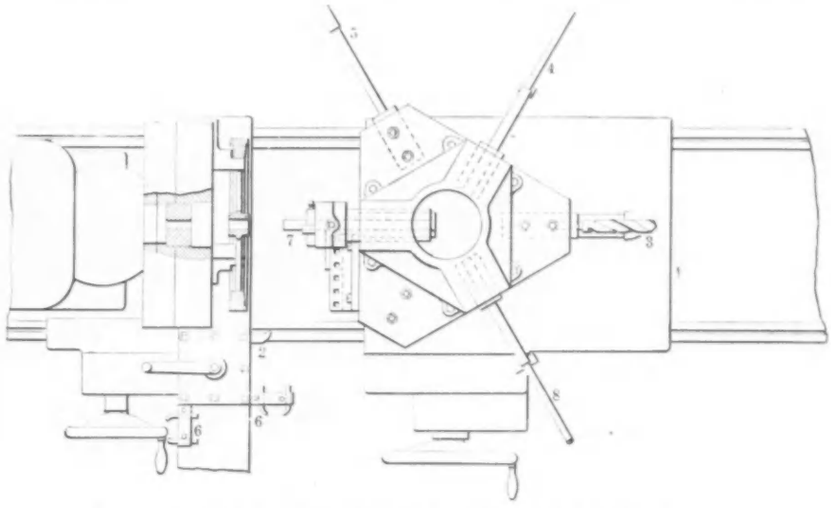


FIG. 5. TOOL LAYOUT FOR MACHINING FLY-WHEEL

Fig. 4 shows the lathe at work in the shops of the Otto Gas Engine Company, Philadelphia, Penn., having just finished the last of 36 fly-wheels in a nine-hour run. Fig. 5 shows a layout of the tools used in this connection, the operations being as follows: These fly-wheels are about 17 inches in diameter by 2 inches face, and are held inside the rim by the special chuck jaws. The first operation

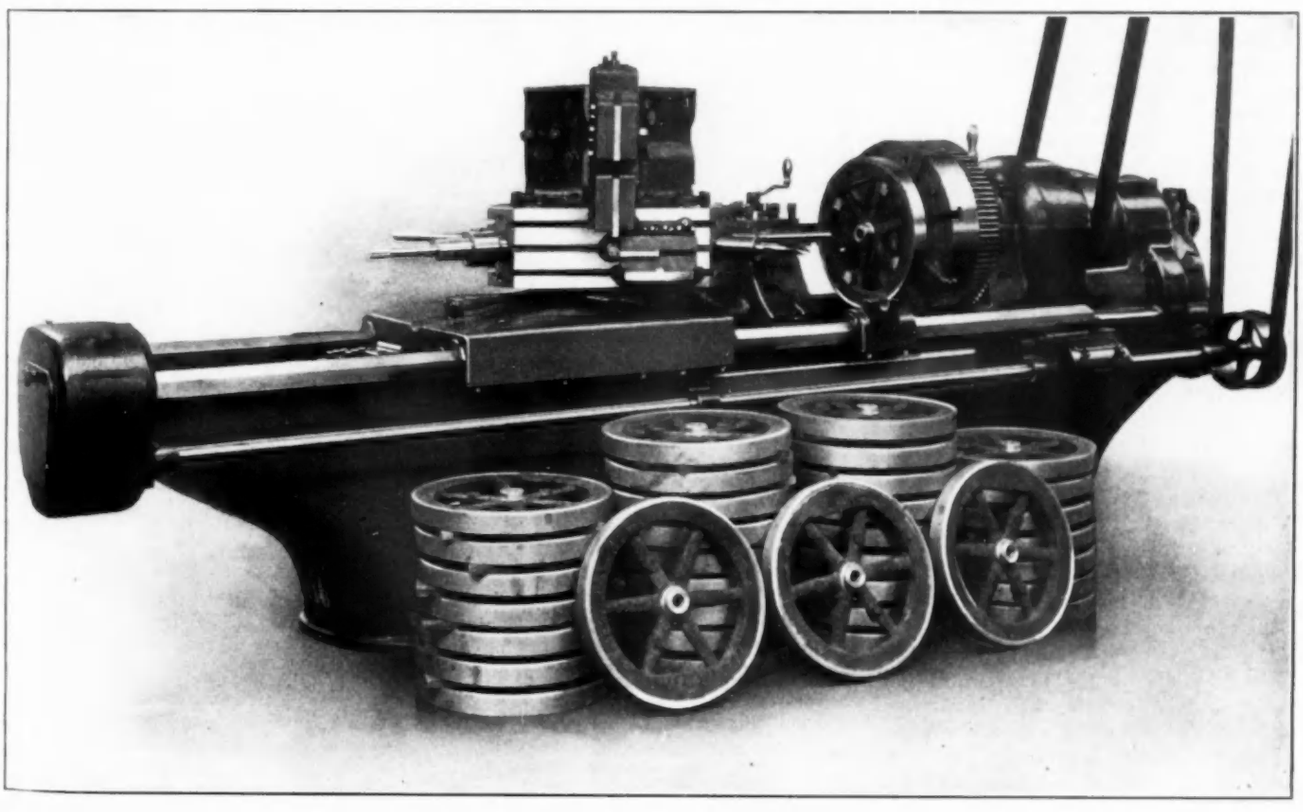


FIG. 4. TURNING GAS-ENGINE FLY-WHEELS

is to rough turn the outside diameter and face the hub with the tools shown in the tool post. Then the 1¼-inch hole was drilled at a speed of 111 revolutions per minute and a feed of 1/16 inch. This was followed by the boring bar and 1 5/16-inch reamer cutter at the same speed, and a feed of ⅛ inch, after which the reamer finished the hole. Then the sides of the rim were roughed and finished, using the straddle tools shown in the tool post. The outside diameter and face of the hub were finished at the same time, using the tools in the turret. Then the back side of the hub was finished by inserting a cutter in the boring bar for that purpose.

The peculiar shape of this turret gives the impression of having only three places for tools, but there are the usual six, and in addition there are three broad surfaces for bolting facing tools in any position desired. This, added to the extension or upper turret, gives a large tool capacity especially when coupled with the turret tool post on the carriage, which can turn the full swing of the lathe as it passes under the chuck.

Precision in Drilling and Reaming Work

By J. G. Vincent*

I have read with interest Mr. McCabe's article at page 623, in which he comments on some of the points brought up by me in an article at page 980, Vol. 30, Part 2, on locating holes accurately. I quite agree with Mr. McCabe in what he says about the advisability of some enterprising maker of light machine tools taking up the manufacture of a precision laying-out drill press. This machine is certainly a great time-saver, not only because it cuts down the cost of making the parts but also because it is entirely unnecessary to inspect the parts after they have been laid out on this machine by a skilled workman. As Mr. McCabe says, this machine might be elaborated upon to a considerable extent and in fact for rather large work it would be quite desirable to have a large, hollow spindle arranged with draw-in collets. The machine used by the Burroughs Adding Machine Company and described at page 963, Vol. 30, Part 2, was first designed and built as an experiment, and in order to facilitate the building of this machine an ordinary bench-drill press was used, this drill press being fitted with a first-class chuck. A platen of a suitable size was designed to take in the small work ordinarily turned out in the experimental shops of the above company and the machine has proved satisfactory in every respect.

*Superintendent of Inventions, Burroughs Adding Machine Company.

Large Miller for Tool Work

In regard to what Mr. McCabe says about the adjustable vernier I will state that since the machine was described in the American Machinist it has been equipped with an adjustable double vernier. This makes it not only possible to set the vernier at zero after the first hole has been drilled, but it also enables the operator to read correctly a setting in either direction from this zero point. This machine proved so satisfactory in the experimental shops that a larger machine has been arranged for the toolmaking department. In arranging this larger machine a Brown & Sharpe standard vertical miller was used and the necessary alterations made. The vertical head was arranged with a power feed and the spindle fitted with suitable chucks, boring bars, etc. The platen and saddle were equipped with verniers large enough to be easily read, the graduated steel strips cooperating with the verniers being made adjustable lengthwise. Thus at a comparatively small extra cost a machine large enough to handle a great variety of tool work in an economical manner and with uniform, accurate results was secured.

Use of the Graduated Dial

I also note what Mr. McCabe says about laying out work by the graduated dials on the feed-screws of milling machines and I quite agree with him that a very good class of work can be done in this way. This is particularly true where the holes to be bored are all within a comparatively small area, say within a 12-inch circle, but I should like to call attention to the fact that in laying out work where the holes are scattered over an area of, say, a 24-inch circle the over-hang of the milling-machine platen will very likely cause a greater variation than the inaccuracy of the lead screw.

Plain Miller with Vernier Plates

Before I had the machine mentioned above designed and built for the Burroughs Adding Machine Company I made an attempt to arrange a machine to do the same class of work by equipping an ordinary plain milling machine with vernier plates. After I had the machine fitted with these plates I could, of course, space the platen accurately, but it was impossible to turn out uniformly good work owing to the fact that the platen had to be moved either in and out or up and down during the boring operation. This difficulty is of course entirely overcome in the machine which I finally had built, because only the spindle moves up and down during the boring operation and the saddle is also made especially long to prevent any possible inaccuracy due to over-hang of the platen.

Boring Holes to Exact Size

Mr. McCabe suggests that I state how I bored the holes to exact size when I used the plan of checking the dimensions by diagonal measurements. I tried a number of schemes while I was doing this work, first using a good three-jawed chuck on the milling-machine spindle to hold my boring bars and reamers. In using this arrangement I provided three boring bars and a standard rose reamer. I first roughed the hole out by taking one cut through with No. 1 boring bar; I then bored the hole nearly to size by one cut with No. 2 boring bar; after which the hole was bored to within 0.005 inch of size with one cut of No. 3 boring bar. This left a good, round hole with so little metal to take out that the rose reamer finished the job in very good shape. The plan worked very well but it had one bad feature, due to the fact that the constant changing of tools made it hard to make the measurements. I therefore finally hit upon the plan of boring the holes to size and found that I could do this very readily by setting the cutter in the boring bar by the use of a micrometer. It was only necessary to use a little care in boring the first hole, setting the cutter out carefully until exactly the right size hole was secured. After this was accomplished it was merely necessary to measure from the point of the cutter to the opposite side of the boring bar with a micrometer and make a memorandum of this reading. It will be understood that as the boring bar was not removed from the machine until the entire job was completed it was only necessary to set the cutter out to this same measurement for the finishing cut on each hole. In making this final setting it was my practice to set the cutter out a little too far and bring the set-screw against it very lightly; then pass my micrometer over the point of the cutter set to the correct dimension, and draw the set-screw up tight. In order to facilitate the setting of the cutter I ground it absolutely parallel on the surface grinder. This may sound tedious but I found it a very rapid way of producing accurate work. I might state that in boring the first hole I used a pair of 6-inch verniers to measure the size of the hole and to determine how much more metal was to be removed before the hole would be to the desired size. After the hole was once bored to size it was, of course, checked for accuracy with a plug gage. In boring holes to size in the manner mentioned I was able to keep the boring bar in place until the entire job was completed, thereby making it a very easy matter to locate the two sides of the boring bar which ran exactly true and mark them to be used in making all measurements.

The Chinese Government has spent approximately $105,000 during the year 1907 in defraying the expenses of students studying in foreign countries. About 70 per cent. of this sum was for students sent to Japan and America, while the remainder was divided among English, German, Russian and Belgian institutions.

Making the Veeder Cyclometer

Some of the Interesting Methods Used in Printing, Threading, Marking and Testing Cyclometers and Odometers in Large Quantities

EDITORIAL CORRESPONDENCE

Probably nearly every reader of this paper knows the name of the Veeder in connection with cyclometers for the bicycle, counters for various machines, or odometers for automobiles or other vehicles, but unless they have seen them apart they can hardly appreciate the nice problem in designing that brings so much mechanism in so small a space, or how large a part die casting plays in its manufacture. It is practically true to say that the whole thing is die cast, the exceptions being the screws, the propeller or star wheel and a few minor parts, but the case, as well as the whole interior mechanism, is put together without any machining whatever. Some idea of what this means can be had from Fig. 1, which shows the parts of a trip cyclometer, which keeps up its continuous count, at the same time allowing you to set the trip part back to zero, so you can see how tired you are without using a slide rule to figure out how far you've ridden.

Printing the Number Wheels

Various plans have been tried to secure numbers that will be plain and clear at all times, and some are made by fastening paper around the plain metal wheels and then printing the numbers on them, as shown in Fig. 2. The plain rings on the bench at the left have been mounted on a long wooden arbor, the paper wrapped around automatically in a sharp spiral so to make the joint short on each wheel, and the wheels cut apart for the numbering.

This numbering must be done in the right place, and the same point which drives the numbering wheel in the instrument itself drives it in the little printing

FIG. 1. PARTS OF A TRIP CYCLOMETER

machine, shown in Fig. 2. The wheel is slipped on the end of a holder which is held in the left hand, the whole thing put on the lower spindle of the machine, and the printing wheel behind it is turned, first against the inked roller and then to the wheel to be printed.

It will be noted that the type wheel is of a larger diameter than the wheel to be printed, but the numbers on the printing wheel do not go all the way round, so that the two spindles have to be geared in the proper proportion as shown. The impression is regulated by the little coil spring over the two spindles, but in spite of this it is not always possible to get every number perfect, and on inspection, some have to be touched up a little. This is what shows the accuracy of the machine, for they are simply put on again and run over and the weak spots are made perfect with the registry exact in every case.

On other styles the numbers are sunk into the metals of the wheels, being taken care of in the die-casting machine. And with these wheels as with the paper-faced, they are printed on the same machine, the printing registering perfectly in the depressed numbers.

Threading the Pinion Shaft

Perhaps the most ingenious machine is the one designed by Mr. Veeder and shown in Fig. 3, for cutting off and threading the pinion shafts, which are of german-silver wire and only 0.04 inch in diameter, with about 80 threads per inch.

The wire comes down from the top through the chuck or holder at the top of the machine, which carries a hardened bushing that about fits the wire. This holder is pivoted inside the two disks shown by front and rear trunnions while these rings themselves swing in the opposite direction on the side trunnions. This

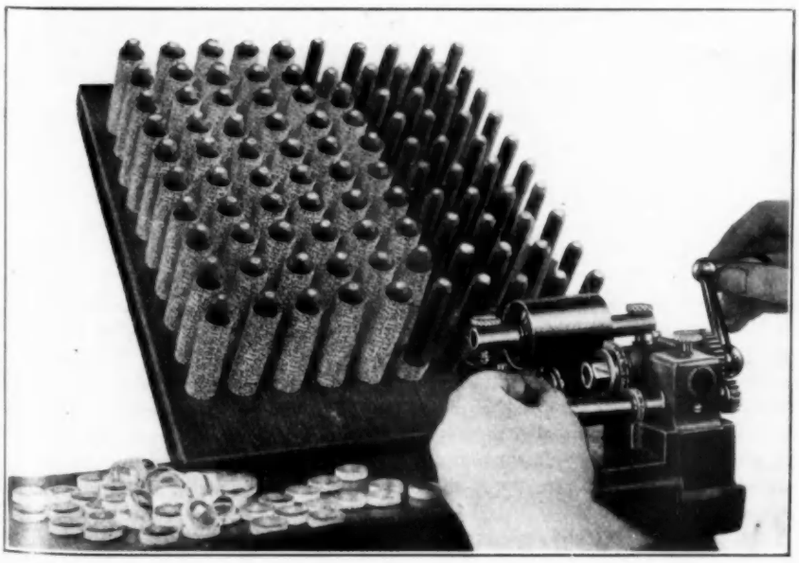


FIG. 2. PRINTING THE NUMBERING WHEELS

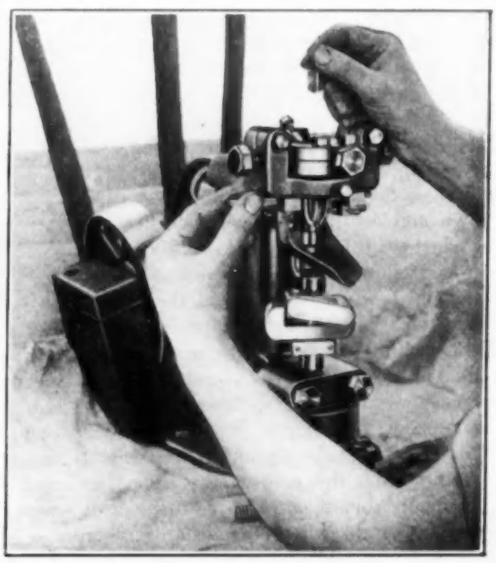


FIG. 3. THREADING AND CUTTING OFF WIRES

gives a "gimbal" joint, and allows the holder inside to assume any position.

Beneath is the driving mechanism consisting of the pulley, revolving spindle and the linked crosshead, with the bent arm or "wabbler" behind. This does not turn, but the crosshead pin turns inside of it.

When the machine starts up the crosshead pin is in line with the spindle below and simply revolves in the wabbler, imparting no motion to it, but when the foot lever is pressed it lowers the driving spindle, increases the angularity of the connecting links and throws the crosshead pin a little out of the center. This makes it an eccentric or crank pin and it carries the lower end of the wabbler with it. This rotates in a small circle, but enough to give a rapid movement to the wire-carrying guide at the top.

Below this, stationary in the frame, is a threaded die or block, for there are no flutes or grooves, and larger than the diameter of the wire, but the wire is wabbled around in this until the thread is rolled in the end of the shaft and cut off at the proper length. The small slide at

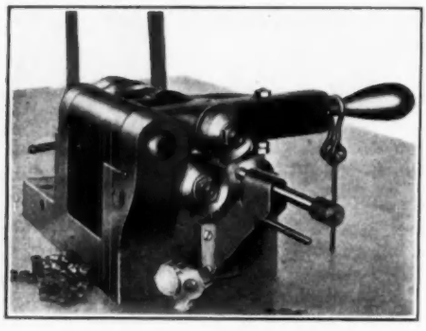


FIG. 4. ROLLING THREADS ON EDGE OF DISKS

the left, just below the head, is the stop which determines the length of the pinion shaft, and as this is released the shafts drop down into the spout and are delivered into a box or other receptacle. No hand work is done except to feed the rod in the machine, and the finished work comes out at a rapid rate.

Rolling Threads on Disks

Another interesting machine is the one in Fig. 4 for rolling threads in the caps shown and on the thin disks which form the dust cap for the end of the case. These caps are about 0.70 in diameter and 0.3125 thick, so that to thread the rim is not a nice job by ordinary means. In this machine there are three threaded rolls, the upper one being mounted on the lever shown and pulled down by a foot lever against a spring which tends to keep them apart. The work to be threaded is placed against the stop at the back, the upper roll brought down so as to pinch it between the three and the disk or other work starts to roll out toward the front, dropping out of the rolls with the thread complete. The only hitch that occurs is when the operator does not pull the upper roll down quite hard enough, in which case the rolls chew off the edge of the disk instead of rolling it in. A decided pinch starts the work rolling and it comes out with a good thread.

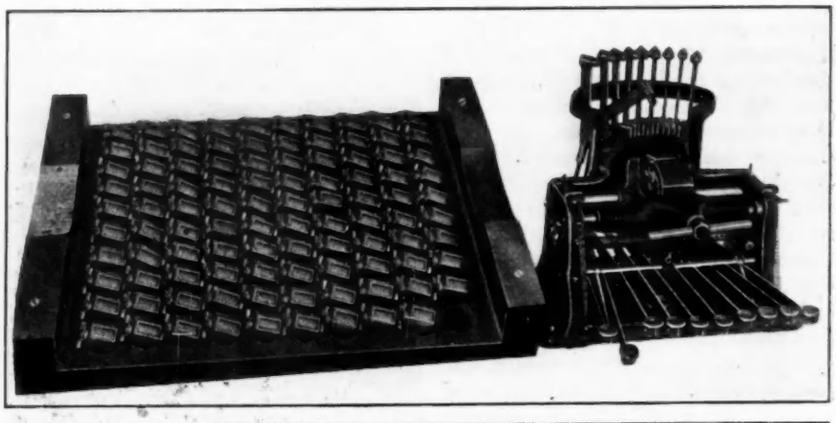
Stamping Serial Numbers

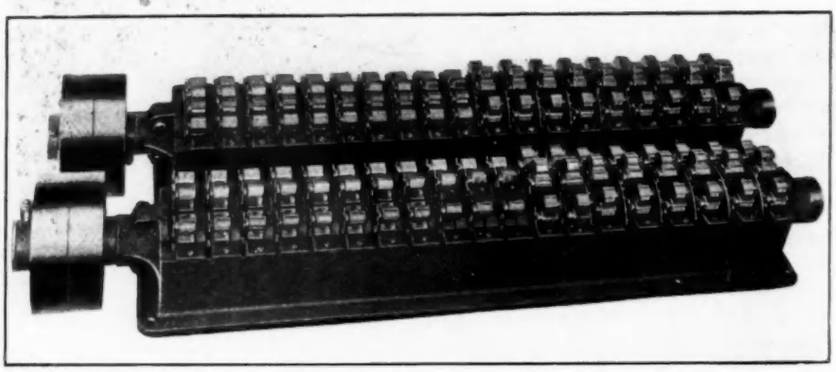
Every instrument has a serial number, as is usual in most shops, but instead of using the hand stamp or anything of the sort, they have a numbering typewriter, as shown in Fig. 5, so that any number can be stamped and it is sure to be in line and properly spaced. This also shows the trays used to handle the instruments and a batch of them ready to be stamped with their serial numbers.

Figs. 6 and 7 show two testing racks or machines, the first for cyclometers and the other for odometers. These are run at a good rate of speed, and the star wheels are turned by the notched wheels in the first case and the pins or strikers at the left of the second machine, while the large odometer wheels are driven by regular gears. The small ones in the center are driven in groups by gearing in the frames shown.

I am indebted to both Mr. Veeder and Mr. Trowbridge for the photographs and information concerning the methods used.

F. H. C.





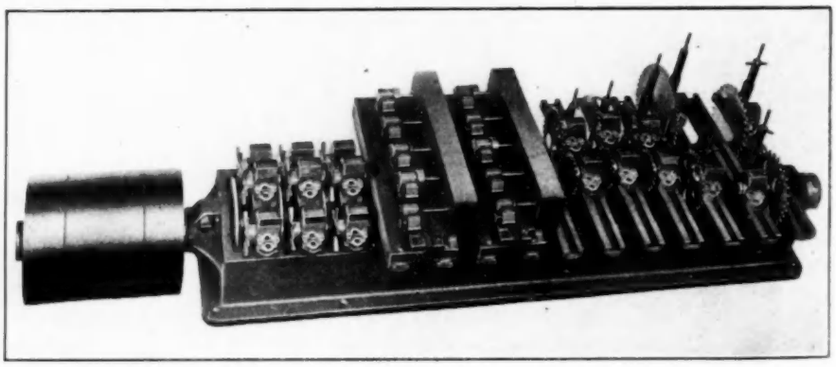


FIG. 5. STAMPING SERIAL NUMBERS WITH A SPECIAL TYPEWRITER
FIG. 6. TESTING RACK FOR RUNNING CYCLOMETER TESTS
FIG. 7. TESTING THE ODOMETERS ON ONE OF THE TESTING RACKS

One astonishing discovery by the use of anchored balloons with self-registering devices at Strasburg, Germany, is an isothermal zone in the air at a hight of about 40,000 feet, in which, contrary to experience in the lower regions, temperature does not diminish with recession from the earth.

Practical Letters From Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

An Improvised Taper Attachment

A chap came into the little jobbing shop where I was working a few years ago and said he wanted a tapered coil spring 4 feet 6 inches long by 1 foot diameter at the large end and 2 inches at the small, with No. 1 B. & S. gage coppered spring wire.

The owner of the shop told him that a spring that size made with such light wire would fall down of its own weight. However, we were told to go ahead, and the job fell to me.

The first thing was to make a mandrel; this was done by tapering a log with the attachment shown at Fig. 1. The log was first stepped down roughly by hand and then a piece of 1½x½-inch iron *e* with one end bent at right angles and a hole drilled for the bolt *c* to fasten it to the tailstock. The other end had a hole drilled for a bolt to connect it with a strap held by clamp *d*. The cross-feed screw was removed from the carriage allowing the slide rest to move easily and the tool *b* set so that it took a proper cut when the surface of the rounded swiveling portion of the compound rest *a* just came against *e*.

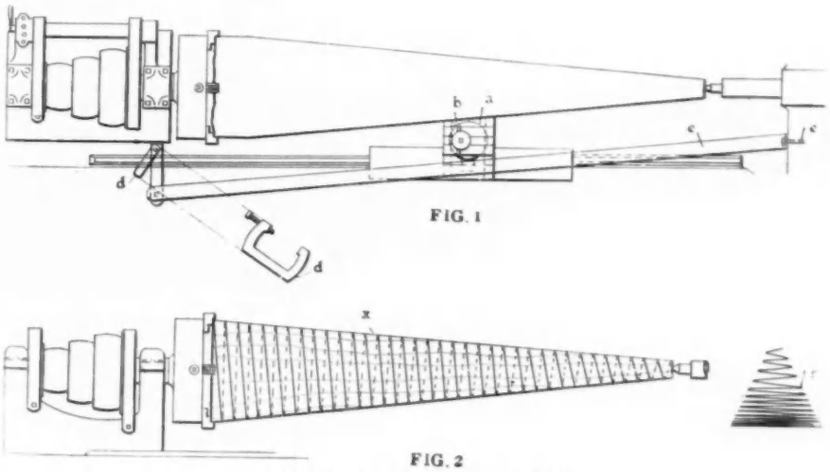


FIG. 1

FIG. 2

MAKING LONG TAPERED SPRINGS

It will be seen that as the carriage moved along it always kept in contact with *e*, thus giving the required movement to the tool *b*.

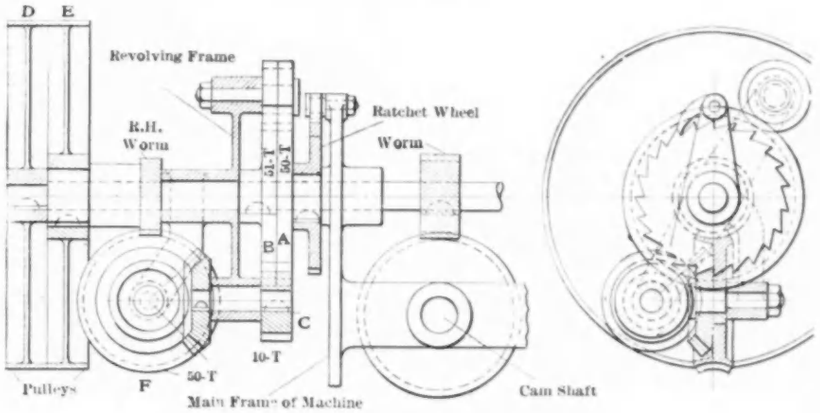
After the mandrel has turned and the wire wound on it at 1½-inch lead per turn it appeared as at Fig. 2, but as soon as it was released it assumed the appearance at *s*.

Ottawa, Canada. W. L. McLAREN.

The Epicyclic Train of the Spencer Automatic Screw Machine

Among the many change-speed devices applied to machine tools is one used on an old-style Spencer screw machine, which is particularly worthy of note on account of its extraordinary speed ratio for so compact a mechanism. It is interesting also as a particular variation of epicyclic gear trains, which have been discussed in the AMERICAN MACHINIST during the past year. The function of this device is the driving of the cam-shaft at two speeds: one rapid to move the tools up to the cut, and the other very slow for the feed. The operation will be readily seen by following an explanation of the cut.

The pulley *D* is keyed to the cross-shaft and drives the cam-shaft directly through a worm and gear for the quick speed. A cam shifts the belt to pulley *E*, which is keyed to a worm running freely on the cross-shaft. The drive is through a worm gear, miters and the epicyclic train. The pinion *C* rolls on and around the gear *A*, and draws the revolving frame with it. The gear *A* is braced by the ratchet and pawl so arranged as not to obstruct the rotation of the cross-shaft with its parts when driven by the other pulley. This rolling of the pinion on the gear *A* lines up with it consecutively the teeth on the gear *B*; when the frame has made one



THE EPICYCLIC TRAIN OF THE SPENCER AUTOMATIC

revolution, the gear *B* has moved forward one tooth.

From the number of teeth in the worm gear, 50, and the ratio between the gears *C* and *A*, 5, it will require 250 turns of the pulley *E* to turn the frame around once, plus one turn to compensate for the motion of the frame in the same direction as the pulley. Consequently the speed ratio between the pulley *E* and the cross-shaft is 251 × 51 = 12,801. The gears *A* and *B* have the same pitch diameter, both being cut to the theoretical diameter of the gear having the greater number of teeth. Thus the pitches of these two gears differ, but so slightly as not to affect their smooth running. If the arrangement of gearing in the revolving frame were such as to rotate it contrary to the driving pulley, the gear *B* would require a less number of teeth than *A*, in order to revolve in the proper direction.

The general formula for the speed ratio is as follows, the letters representing the numbers of teeth in corresponding gears:

$$Ratio = \left(\frac{AF}{C} + 1\right)B.$$

The upper sign is used when the frame revolves with the pulley.

New Haven, Conn. H. S.

Notes on Punch and Die Design

As there is a growing practice, especially among the larger concerns, of designing punches and dies in the drafting room, instead of giving the toolmaker or diesinker a templet, and depending on him for the method of construction as heretofore, the following extracts from the notebooks of some tool designers who have had extensive experience in this class of work, may be of service to some readers of the AMERICAN MACHINIST.

In cases of progressive dies to blank and shave, when the pilots on the blanking punch cannot be depended on to keep the stock in position while shaving, the stop should be on the side of the stock nearest to the shaved position. In case of a shaving die, allow for 5 per cent. of thickness of stock to be removed.

In blanking dies parts of the outline of the blanks that are subject to wear should be laid out as far as possible at an angle to the grain of the stock.

Blanks which are to be formed up should be laid out on the stock in such position as to bring the bends in the blank lengthwise of the grain of the metal.

Arrange stops so that blank outlines do not approach each other closer than 70 per cent. of thickness of stock. Lay out blanks in position to use square-ended stock if possible, or so that stock can be trimmed on plain shears. Give solid strippers preference over spring strippers whenever possible. The hole in the die is to be tapered 1½ degrees on a side.

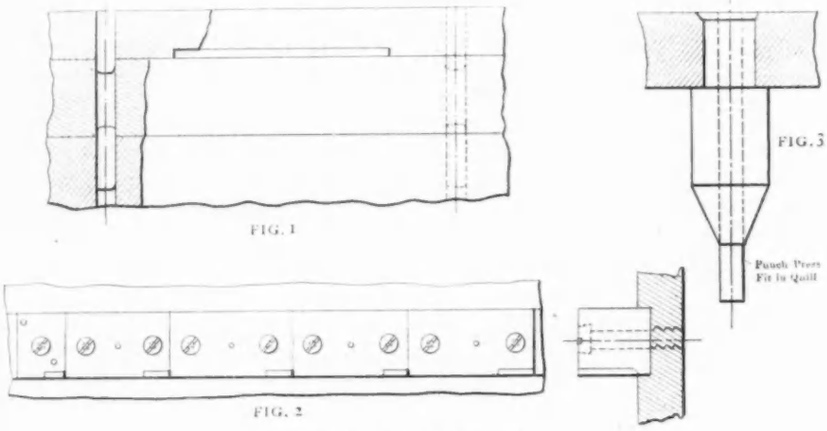
Allow clearance between punch and die equal to 5 per cent. of thickness of stock. Remember that the top side of the blank conforms to the size of the punch, and the under side to the size of the die.

When doweling stripper and die plate to the bed, drill holes straight, but use two dowels in each hole as in Fig. 1. One dowel should be tight in the bed with ¼-inch control in the die plate, and the other similarly fixed in the stripper with control in the die. The object is to avoid risk of unsetting dowels by driving out when the die has to be taken apart for grinding or other reasons.

In cases of long punches or dies which are liable to warp in hardening, it is advisable where possible to divide them into a series of sections tongued, doweled, or otherwise connected, as in Fig. 2. In this way the inaccuracy per section is reduced and may be rectified by grinding.

In cases of small punches which have to project a considerable distance from the punch plate it is advisable to use what is known as a quill, Fig. 3. This is really a machine-steel bushing, driven into the punch plate, and as the punch is simply forced into it, it not only supports the punch close down to the work, but also renders it easy of replacement.

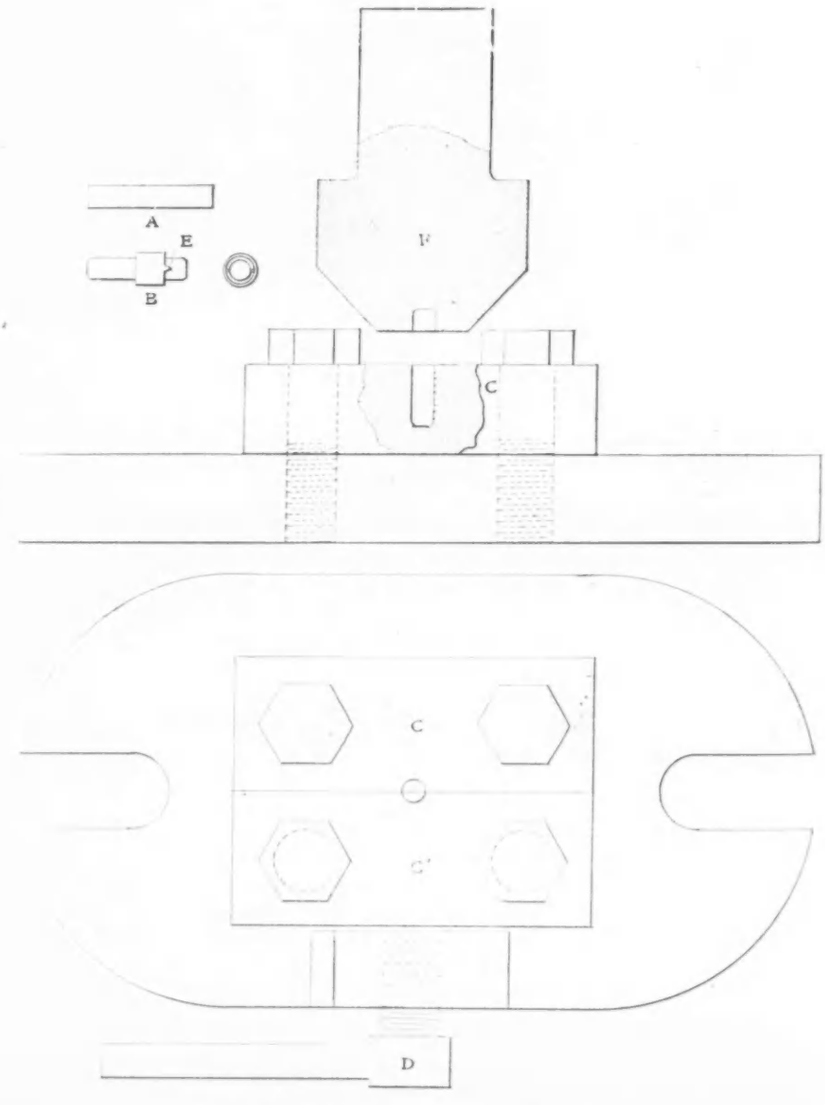
Detroit, Mich. C. F. HOWSE.



PUNCH AND DIE DESIGN

Making Studs on the Punch Press

For stock we use ¼-inch cold-rolled shafting, cutting or rather chopping it off on the punch press into 1½-inch lengths as at *A*. The lower forming element is merely a grip-like affair, the blocks *C* and *C'* being hardened steel. *C* is fastened securely to bolster, *C'* having the bolt holes elongated to allow movement for



MAKING STUDS ON THE PUNCH PRESS

the block, in and out, the bolts or screws being just tightened enough to allow this freedom. Each block has one-half of a ¼-inch hole in it put to the proper depth and a fillet left at the bottom for beveling the ends of the work. When the blocks are set together by the hand-screw *D* the one-half holes meet and form a complete circle. The upper element or punch *F* is a solid piece of steel having another ¼-inch hole the proper depth and also has a fillet at the bottom and a small notch at each side, which leaves a small sharp projection, as at *E*, on the work. The punch and dies are shown at the closed position. In operation, with the punch clear up, a blank *A* is dropped into the hole in the die, the hand-screw *D* closed, the punch descends the required amount and as the stock is supported everywhere except between *F* and *C*, the metal has to flow or bulge at that place, forming a body which has small but clean, sharp shoulders next to the stem. The fillets in the bottom of the holes make a chamfered corner for easy threading, the little projections are sharp and clean for gripping a brass piece when secured with a nut. The dies grip the work tight enough for the punch to pull off and then the screw is loosened and the piece knocked out by hand. Of course the knock-out could be automatic, and will be so eventually, but this shows a slow and tedious job taken from a high-priced lathe and put on the press with cheaper help and an increase of speed very close to 4 to 1.

H. E. S.

Upland, Cal.

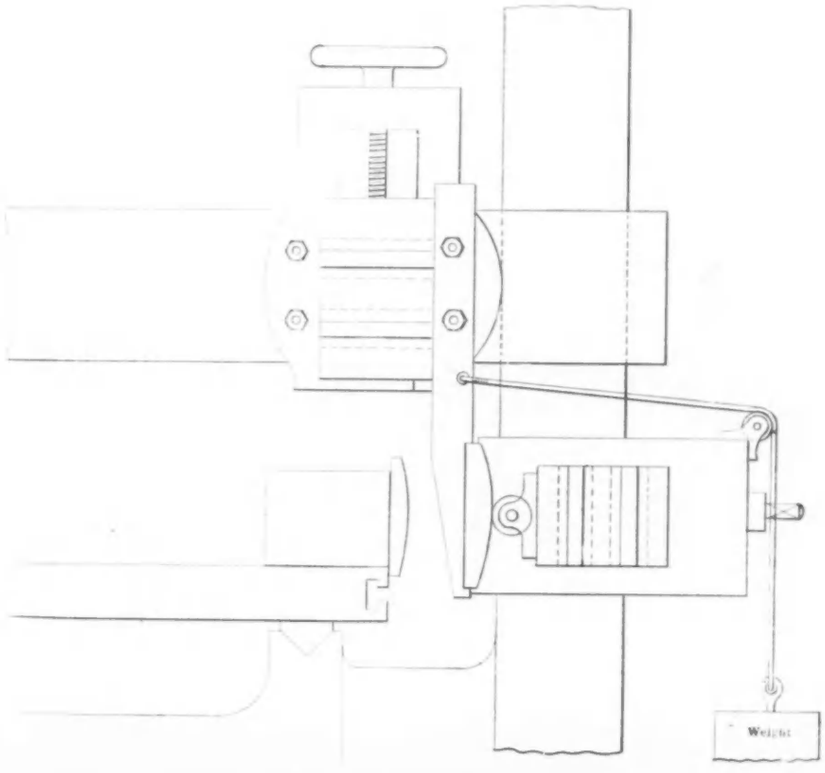
Planing Curved Faces

Some time ago there appeared in the AMERICAN MACHINIST a method for planing circular or curved faces.

I had a similar problem to solve and my solution, shown by the accompanying sketch, may be of use to some readers. One advantage claimed is that the cut is as easily regulated as on flat-surface work, by moving the horizontal or side tool box to which the cam (or former) bar is fixed. The bar was made of ¾x4-inch mild steel, and is held in place by the bolts of the swiveling device. The weight used was about 100 pounds and held by 3/16-inch wire rope.

The cut-adjusting screw in the side box must be removed or slackened sufficiently to allow for the length of travel of the slide when going round the cam. Care must be taken when setting the tool that the roller is on the crown of the cam when the tool point is right on the center line of the piece to be machined.

Rugby, England. OSWALD B. DAVIES.

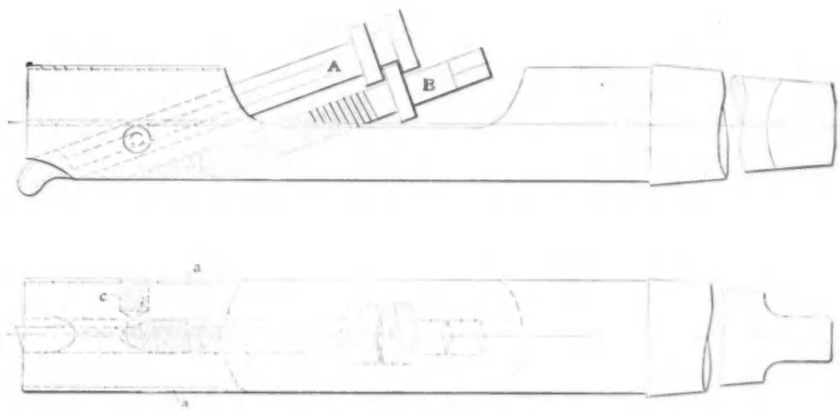


PLANING CURVED SURFACES WITH THE SIDE HEAD

A Recessing Tool

The illustraton shows a recessing tool used in locomotive shops. It does very effective work and makes a clean job, being used almost exclusively on connecting-rod oilcups before they are tapped.

This tool is made the size of the tap hole, say the smallest standard used, the two medium sizes and one or two sizes below the largest; this makes a very good general run, and by using steel bushings for the intermediate sizes almost all standard sizes can be had with only three or four complete tools.



AN OIL CUP RECESSING TOOL

The body is made of machine steel case-hardened, after which it should be ground true all over.

The cutting tool *A* is made of tool steel tempered. The keyway is splined or milled on the top of the cutter because in order to get the rake on top it is necessary to grind a certain amount away which invariably takes the whole keyway out at that part before a sufficient amount is ground off to secure the proper shape and edge; another reason is that if the key-way was cut on the bottom it would shorten the life of the tool by weakening its own support and thereby causing it to break.

The feed screw *B* is also made of tool steel, but the shank and collar only are hardened and drawn, the screw part being left soft. Thus two parts, the cutter and feed screw, are made ½ inch diameter for all sizes of body in order to have a standard, so that if one breaks and there does not happen to be any in stock, the operator can in a minute take a cutter or screw out of another body, put in the one he is using and go ahead.

The screw *C* acts as a key for the cutter *A* and when bushings are used to

increase the diameter, a longer screw is used and the head projects up into a drilled hole in the bushing as an auxiliary means of holding it, as the bushings drive on lightly.

The four oil grooves marked *a* provide plenty of oil both for lubricating purposes and to facilitate cutting.

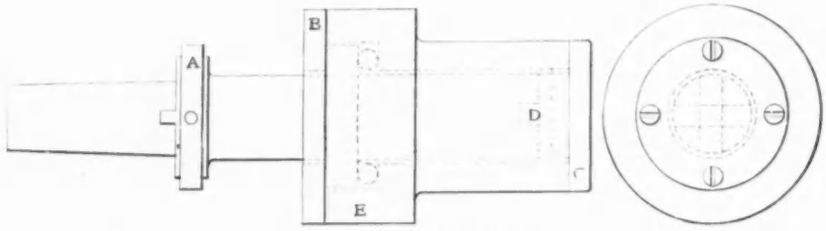
This tool is used on a drill press alongside of what is called a rod drill while the big holes for the boxes are being cut out and reamed with the cat-head, the latter work requiring very little of attention on the part of the operator. The oil cups on a number of rods are first drilled and cat-headed and thus recessed, after which they are tapped.

To use this tool the cutter *A* is first raised by means of the screw *B* until the cutting edge is below the surface of the tool; it is thus inserted in the oilcup space until it just touches the bottom, when the drill is started and made to feed up by putting a cross belt on the feed cones and on every revolution of the spindle the operator gives the feed screw *B* a half turn with an open-end wrench, thus feeding the tool down and out. Feeding it down, of course, counteracts the feeding up of the machine and by feeding out it cuts a groove in the hole around the bottom and in the side. When this is deep enough the operator allows the tool to feed up automatically, without any more attention on his part until the proper hight is reached when he stops the machine, lowers his spindle, screws his cutter back and takes his tool out.

Newport, R. I. S. E. L.

A Floating Reamer Holder

This floating reamer holder has been in operation for three years and makes a perfect hole, even when the job is thrown out of center 1/16 inch.



FLOATING REAMER HOLDER

A is a threaded collar for forcing the shell reamer off the arbor. *B* and *C* are plates fastened onto the body by screws. *C* has a projecting piece machined for a sliding fit and engaging with *D*, which has also a sliding motion with the end of the shank, enabling the reamer to move 1/16 inch in a circle, while maintaining its parallel motion. The thrust is taken by the balls, which are kept in position by a thin washer, not shown. A couple of springs at *E* located at two points round the flange, and kept in position by a screw hold the reamer central.

A. SANDERSON.

Nottingham, England.

Direct Fractional-reading Micrometer

The accompanying drawings show a direct fractional-reading micrometer on which a patent has been allowed. While approximate readings in 64ths, etc., may be obtained by the graduation on hub *B*, Fig. 1, as on an ordinary inch scale the exact reading of 64ths, etc., may be obtained only by reference to graduation on movable thimble *A*. There are but eight places on *A* which coincide with the long graduation line on hub *B* when any 64th, 32d, 16th or 8th is being measured and each of these eight places is marked with a line and the 64th, 32d, 16th or 8th for which that line should be used is marked thereon, as at *a* and *b*, Fig. 2; *a* then being used for 3/32, 7/32, 11/32, etc., (*b*) for 1/64, 3/64, 17/64, etc.

Now suppose we wish to set accurately 15/32 inch. We first read it roughly on the inch scale on sleeve *B* by turning thimble *A*. Having approximated it closely by drawing the edge of *A* over that graduation we find that the line *a*, Fig. 2, on *A* very nearly or exactly coincides with the long line on *B*. By bringing the two together we have the exact measurement of 15/32. The graduations are independent of the old and may be used equally well with or without the 40 on *B*, the 25 on *A*. Fig. 2 shows a graduation differing from this in two respects. Instead of using the regular zero line on *A* as a base line, a point is taken one-fifth of a turn around *A* and the graduated scale on *B* is placed to correspond. Also instead of making lines *a*, *b*, etc., on *A* full length I make them about half an inch long and entirely omit the numerators, placing the denominators at the end instead of under the line as also shown in Fig. 3. To the ordinary user of the tool this is all that is necessary for a clear reading of the fractions.

CHARLES A. KELLEY.

Spring Lake, Mich.

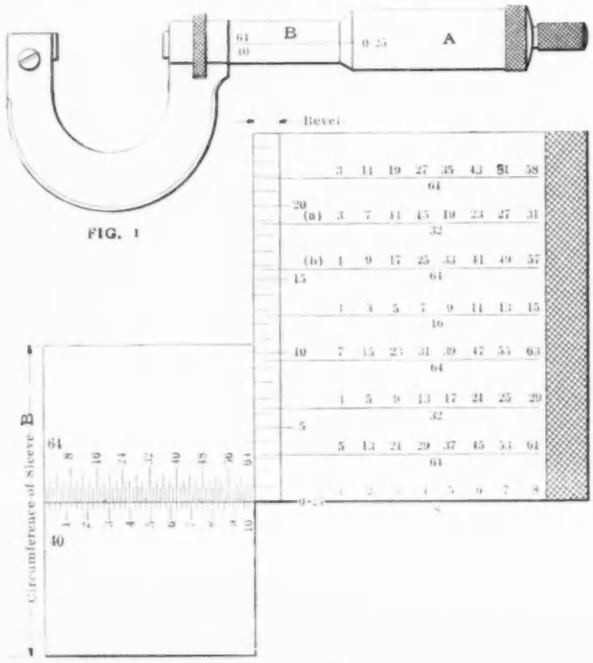


FIG. 1

FIG. 2

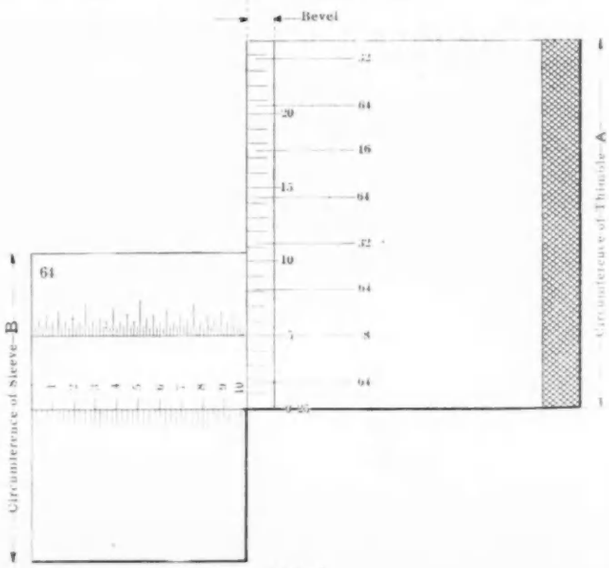


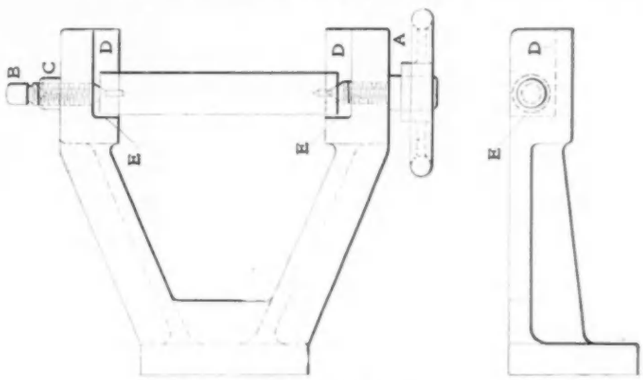
FIG. 3

DIRECT FRACTIONAL-READING MICROMETER

A Reel Bracket

The illustration shows a convenient bracket for supporting a reel arbor which is arranged to turn on centers, and which is frequently removed to be reloaded. The ordinary type of such brackets consists of a plain fork, holding two cone-pointed set-screws. One of these screws must be turned with a wrench, while the arbor is held by the operator who is doing the work. This is often a trying task, especially if the reel is heavy, while much time is consumed by the constantly repeated operation of adjusting the screws.

To use the bracket shown, the following course is pursued: The screw stud *A* with a cone point, is set so that its shoulder is tight against the frame of the bracket. The center in the arbor is



A REEL BRACKET

then placed over this cone point and held in position while the cone screw *B* is properly adjusted at the other end, and locked with the nut *C*.

By turning the hand wheel back, the cone on *A* will release the arbor, which may then be loaded.

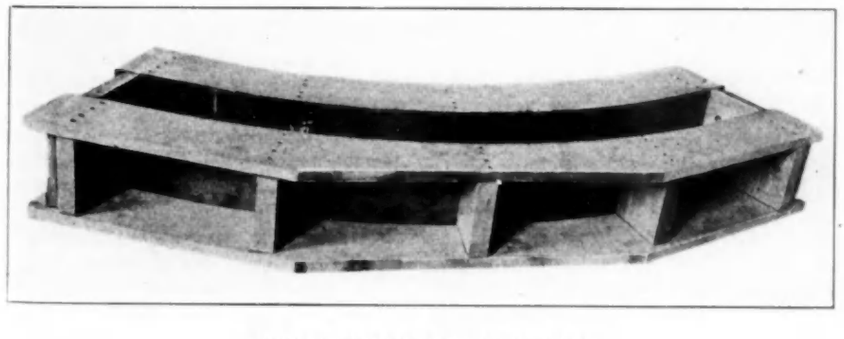
When loaded, the ends of the arbor are rested on the ledges *D D* of the bracket. These ledges are so finished that they will not allow the arbor to fall between their inner sides. The arbor, with its entire weight held by the bracket, is now rolled back until it touches the wall *E*, when it will be in line with the centers on which it turns. The hand wheel is now turned to advance the cone on the stud *A* until the shoulder is tight against the frame. The two cone points, having been once adjusted, as already described, need no thought now or later until the arbor centers are worn enough to require a readjustment.

By construction, the cone centers will lift the arbor from the ledges *D D*, and draw it away from the walls *E E* sufficiently to prevent its binding while the material it carries is being unwound. The advantages of this arrangement, both in ease of operation and in the saving of time, are so great that the increased first cost of making the bracket is insignificant.

Brooklyn, N. Y. B. C. HAY.

Using Sheet Metal for Core Boxes

The half-tone shows an application of sheet iron to a core box and it illustrates



CORE BOX LINED WITH SHEET IRON

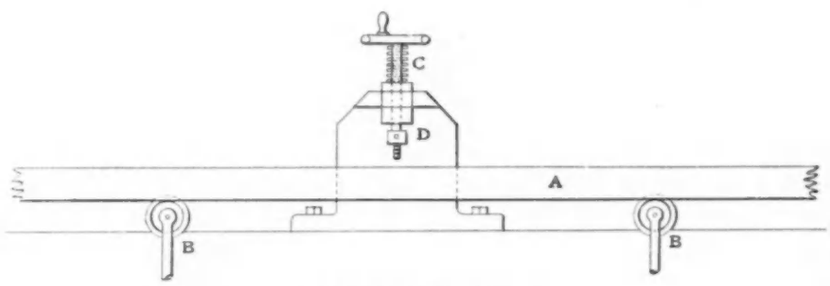
a method that is applicable to semi-circular core boxes, straight pattern barrels or any other curved surface that is usually built up of staves or segments. On temporary patterns or core boxes I have used heavy paper just nailed on.

By building up a suitable framework, which can nearly always be done with the aid of the band saw and other machines, very much hand work is saved; and hand work which is the most expensive kind. The sheet iron leaves a smooth surface without glue joints to open, which interferes with the drawing of the pattern or the core, and the curve adds a stiffness that a flat sheet would not have. I think this core box was made in a little more than half the time that it would have taken to build it of segments and work it out, and I consider the result superior. There are other materials than wood of which to make patterns; and a combination of different materials at times will give results far superior to the practices commonly followed, which illustrates the value of one's thinking about the way things should be done. I am sure this will be useful to someone and be of profit to others than myself.

Denver, Colo. J. L. GARD.

A Hand Tapping Device

The sketch shows a tapping device I saw the other day for tapping small holes in long rails of gray iron, each rail having about 100 holes in a line with each other. The rails *A* are slid along on the rolls *B*, and the tap which was No. 8-30 is held in the small holder on the end of the spindle *C*. This spindle is a running fit in the stand *D*, fastened to the bench, and on the part of the spindle above the stand there is a light coil spring just heavy enough to balance the spindle.



A HAND TAPPING DEVICE

The operator shoves the rail along until the hole to be tapped is in line with the tap and then pushes down on the spindle and revolves it. In this case of a 30-thread, if he wanted to tap ¼ inch deep he would revolve the spindle eight times and then back it out and shove the rail along to the next hole.

This device is much faster than ordinary hand tapping and insures the holes being tapped straight.

Lowell, Mass. PAUL W. ABBOTT.

Electrogalvanizing has become one of the stable and satisfactory operations in the art of electroplating. It has not replaced hot galvanizing to any extent, but rather nickel, copper or brass plating. It forms a far better protection for iron or steel than any other electro deposit.

Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

WE PAY FOR THESE ALSO

Hobbing Bevel Gears with a Taper Hob

I have read with great interest the article by Mr. Gregory on this subject on page 344 and wish more information on some points.

In the first place I should like to know if this machine has already been built and if these hobs have been used for this class of work. The idea of the taper hob with a constant angle, the arrangement of the machine for traversing the taper hob, the mechanism and the movements generally I consider are ingenious, but I cannot quite see how it is possible to hob out a bevel gear by this process. I don't know whether I can make myself quite clear with regard to the point that I cannot understand, but it seems to me that if the hob had been intended to cut all pitches within its range as well as all numbers of teeth that it might have been quite feasible if you ignored the fact that the teeth on the one side of a line dropped from the center of the gear to the hob are not different to the other. Of course this remark only applies when you are cutting spur gears, but when you begin to cut miter or bevel gears there is another difficulty, which in my mind is a great one; that is, all the teeth are not at right angles to the axis of the hob.

There is only one point where the teeth are actually in the above mentioned position; that is when they are on the lowest point of the gear being cut. As they rise up the sides they take an angular movement from the apex of the pitch cone and I cannot see how this is gotten over.

In order to make this more obvious I should be very pleased to see some remark from the writer of the article, explaining how a crown wheel can be cut by this hobbing process. This seems to be the extreme, and I may say that I have studied this question myself. It may be fortunate for me that I commenced with the crown wheel and came to the conclusion that it was practically an impossibility to cut a crown wheel with an ordinary solid hob.

Any light that can be thrown on this subject, I think no doubt would be appreciated by a number of your readers.

VINCENT GARTSIDE.

Rochdale, England.

The article on "Hobbing Bevel Gears with a Taper Hob" has puzzled me somewhat.

I understand very well that the thickness of a tooth and the pitch varies uniformly on a bevel gear. The diagram illustrating the principle of how a bevel gear should be cut by a conical hob is also understood and the general arrangement of the machine as illustrated by the different views is quite easy to comprehend. What I do not understand is how it is possible to cut a correct shaped tooth with the tapered hob, having a varying thickness of teeth and pitch. If hobbing a gear is correctly understood by me, the

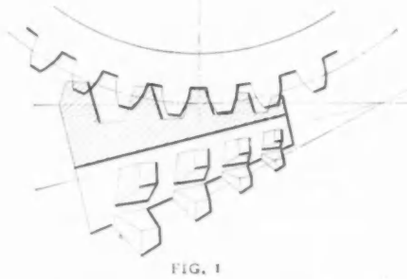


FIG. 1

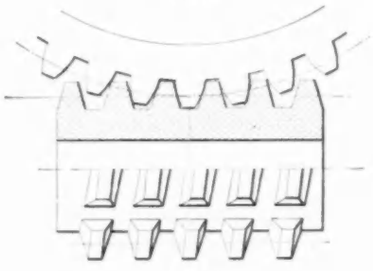


FIG. 2

ACTION OF HOBS IN HOBBING GEARS

cutting and shaping of the teeth on the gear is not done by one single cutting tooth on the hob; a number of teeth on the hob are used to cut and shape a tooth. Probably all the teeth of the hob actually in contact with the gear blank serve to give the shape to the gear tooth. With varying thickness and pitch of the teeth on the hob it seems that, at the best, it would shape one side of the teeth on the gear different from the other side. If the gear cut was so large that the greater part of the length of the hob was used when cutting, I am inclined to think that there would not be any teeth cut at all. In case teeth are produced, I believe they would be anything but correctly formed.

The diagrammatic drawing Fig. 1 shows a conical hob of varying thickness of cutting teeth and pitch cutting a gear. This drawing shows plainly my reasons for advancing the argument that a conical hob will not cut proper teeth on a gear. The gear teeth are indicated in the drawing as uniformly spaced. The conical hob with varying teeth and pitch as described in the article referred to is also outlined. The amount of the gear that comes in contact with the hob when cutting the teeth is clearly shown. It can be readily seen that the hob at the large end would cut away the metal of the gear blank where the teeth should be formed by the rest of the hob. It might be said that the proportion of the hob is exaggerated, but this is done purposely to clearly show what would take place. These conditions would exist even if the hob should be only slightly tapered.

Fig. 2 represents an ordinary hob cutting a gear and shows that the shape of the gear teeth are formed by several teeth on the hob. To keep the angle of the spiral constant on a taper hob can, of course be done readily; it is only necessary to make the diameter accordingly. However, the pitch or the distance from tooth to tooth of the hob is what is essential. Varying the pitch of the teeth on the hob will always crowd in or cut away parts of the gear tooth.

Ordinary straight hobs of different pitch have in many instances the same angle for the spiral but the hobs are, of course, of different diameters. Although it does not seem possible to me to produce teeth on a bevel gear by a taper hob I am ready to be convinced, providing my reasons for not being able to cut teeth are downed. Probably others beside myself would appreciate more information on this subject.

New York City. J. A. SVENSSON.

Mr. Gregory in describing the hob, states that "The thickness of the tooth of a bevel gear varies in proportion to its distance from the apex." This I will grant is perfectly true but has Mr. Gregory taken into consideration that the angle of the tooth varies with every ratio of bevel gearing? Will Mr. Gregory kindly oblige us by describing the way in which this is overcome in the hob he describes for cutting bevels?

My interest in gear cutting and gear-cutting machines has prompted me to send this question for Mr. Gregory to answer. I have control of a plant of gear-cutting machines of all distinct types, including Brown & Sharpe, Fellows gear shaper, Bilgram's bevel planers built by Reinecker, hobbing machines by Schiechardt & Schütte, also Bienatzki. I have had a good many difficulties to get over, some with complete success and others

well, they have gone through and that is all one can say about them. The longer I live and the more I see of gears and machines both as regards their practice and theory, the less I seem to know. I have written to a good many machine manufacturers about gears. They all write very nice letters in reply but always say they cannot advise me as they are in the same trouble as I am, that is noise and that is the one thing at the back of my question to Mr. Gregory. If he cannot give a satisfactory answer that will get over the trouble mentioned, he cannot produce silent gears without making a hob for every ratio and that would preclude the use of such a machine because of the expense.

London, England. H. H. WILSON.

[Copies of the first and third letters were sent to Mr. Gregory and following are his replies.—ED.]

Even the subject of spur and worm gear odontics is very little known and is difficult to understand. Much more so is the odontics relating to the application of a taper hob or worm and a bevel gear. I understand and appreciate your correspondent's difficulty in expressing himself clearly in asking his question; much more is the difficulty in answering so that one can truly grasp the principles involved.

Perhaps the simplest way is to draw an analogy from the well known parallel worm and spur gear. In this the tooth is developed by the molding process of the hob teeth, which move in a straight line at the same velocity as the pitch line; the odontoid is an involute. Suppose now that the spur gear is reduced to a mere lamina. It is obvious that the teeth will be formed as before, also if one has a series of those laminas of different diameters, whose separate generating hobs are in the same proportion, in order to give the same number of teeth in each case, one will obtain correct teeth in all. Therefore, if these laminas are placed upon an axis, the diameters arranged to give a cone and each individual lamina is cut by its respective hob we would have formed a correct odontoid.

This actually takes place in the system mentioned. The variation of the pitch of the hob is obtained by means of a taper, or one of varying pitch.

One immediately says "so far so good," but what about interference? This is really the most difficult thing to avoid and one which without careful thought seems unsurmountable. I will endeavor to point out the manner in which it is overcome.

In the extreme case of a crown gear we have, as mentioned, the center line of the teeth radiating to the apex and causing the teeth on either side of the central contact one to be inclined differently to it. Now, as they are on the pitch cone they are not in the same plane as the cutting portion of the hob's pitch line, but a certain distance away as in the case of spur gear and worm contact. As the hob has teeth upon it in the form of a thread of increasing pitch it is obvious that this thread must be inclined at the spiral angle to the axis, and that in order to cut a gear of straight or radial teeth, this thread must also be radial. That is to say the hob's axis must be inclined to the tooth the same as in the simpler case.

Now, I hope this will be perfectly clear. If we imagine a plane tangential to the cone pitch surface of a crown gear, and the respective tooth center lines projected on to this, they will all radiate on both sides and appear to get closer together. Suppose also we draw a line at say 35 degrees to this central tooth line. It will cut all other lines on either side, the respective distances along this line decreasing on one side and increasing on the other side, because in one case they are approaching the apex, while in the other getting further away. Thus we see that by inclining the hob axis at a certain angle, and it must be so inclined, and arranging for a decreasing pitch portion to be nearest the apex, interference is avoided on both sides, thus allowing the central contact portion to be finished under its proper conditions.

As regards the building of a machine and the use of hobs in practice, I may say that both machine and hob are well out of the experimental stage, and investigation and results prove that everything will have a successful issue.

Manchester, England. E. GREGORY.

Your correspondent has before him the most practical consideration in gearing, that is, that the final result must give a quiet transmission of power and motion. This question has gained in importance in late years and has been especially troublesome in the construction of automobiles where any noise, be it in engine, gear box, or axle, is considerably accentuated by the "sounding-box" design of the body-work. A great improvement has been noted in gear-cutting practice and design, and I shall endeavor to point out its trend.

One readily agrees with your correspondent that the further one progresses the more there is to learn. For example, two gears are absolutely quiet in one box, but when placed in another which to all appearances is identical, they are by no means so. Why? The center distances are the same, the same pattern was used, the castings were machined interchangeably and assembled in the same manner. Well, in this particular case it was found that the shaft was an easier fit in the box in one bearing than in the other.

On motor-car work, and other work for that matter, draftsmen have been found "cutting down" the strength in hopes of reducing the weight. It has been found by experience that by increasing the strength of shafts and preventing vibration or "whip" silent running has been attained. Another factor is that in many cases the gears are made of cemented mild steel or phosphor bronze, which will have a high note when struck. Thus when the pressure is transmitted from tooth to tooth there is a tendency to "hum." The tone rises with the speed. I believe this also is due chiefly to vibration, because by the insertion of a ring of lead or similar substance it is avoided. Cast-iron gears are often quieted by this method.

I have, of course, eliminated the consideration of inaccuracies in mounting the gears either for cutting operations or for running, also the necessity of keeping the machine properly adjusted. But as your correspondent is a practical man, I doubt not but he is fully alive to the importance of these points and has already given them his consideration. The process of heat treatment of gears after cutting will, in all probability, produce distortion and cause noise. This is why many manufacturers are discarding the method of case-hardening mild-steel gears after complete cutting, and are substituting a steel alloy of from 60 to 100 tons strength, which is finished by cutting after heat treatment. The steel is very hard and strong.

This brings before us another point and that is the wearing away of the cutting tool, especially when the material is hard. An extreme case is in mind in which, while planing on a Bilgram machine it was necessary to regrind the cutter about every one or two teeth. Errors in resetting crept in and the gears were far from satisfactory, which was entirely due to the teeth not being of uniform thickness. Every endeavor must be made to see that all the teeth are cut the same, and to a correct thickness. I have found that with centers about 0.002 to 0.005 full (according to size) quiet gears can be cut and made to run quietly when attention is paid to the foregoing points on either a Fellows, Bilgram, or a hobbing machine, provided, of course, that the cutters are correct. With a rotary cutter one must also see that the cutter contour is right and that it runs true, because such a machine is not self-generating.

In cases where there are gears of considerable difference in diameters running together, it is often very advantageous to cut them to suit each other, adjusting the pitch diameters and outside diameters to prevent undercutting or weakness of the blanks and avoiding interference. When these conditions exist, especially when cutting less than 20 teeth, this method will overcome the difficulty and allow the hob to be used to obtain equally silent gears.

I hope these remarks will be of value and of some understanding to the general body of readers, but even then each case deserves a more individual treatment and not a general summary.

Manchester, England. E. GREGORY.

State-supported Trade Schools

The State of Massachusetts is up against the proposition to which your editorial on page 256 calls attention. The conditions are a little different, yet the same principles are involved. The problem for immediate solution is the taking care of boys from 14 to 18 years of age, keeping them off the street, making men of them and having them acquire a trade. You will note that I avoid the term "teaching" a trade; of which more later.

Besides the boys there are three other interested parties in this problem: The workmen in shops making a product in the line in which the boys are to be trained, their employers and the general public. The workmen are concerned for fear that the competition of unpaid boys in untaxed shops will lower their wages; the employers are concerned for fear that the sale of school-made goods will lower their prices; the general public fears that its taxes will be increased to make up the school's deficit.

I will assume that all will agree with you that if a boy is to do commercial work the way for him to learn to do it is to do it, and keep on doing it until he can do it well. Here is a point that we have all missed. While we speak of "teaching a trade" in the sense of aiding a boy to acquire a trade, to the professional educator teaching means the implanting of new ideas in the student's brain. Teaching, as they see it, has no place in the formation of habits of action. We speak of teaching a boy to ride a "wheel." All the teaching in the world will not help a boy one iota when he first gets on the machine. The principles are easily taught. When you tend to fall to the right, turn to the right. But the boy does not live that can think quickly enough, and make his muscles respond to his thought quickly enough, to save a tumble. After a more or less complete course of tumbles, without taking the slightest thought as to his instructions, he gets where he can keep himself up involuntarily. He can even think about something else while he rides.

The same distinction must be made in "teaching" a trade. Ten minutes time will "teach" a boy to cut a V-thread. That is, he can pass an examination on it and tell his teacher how to do it. But he cannot do it himself. He cannot do it with any certainty as to the results until he has put in at least 20 hours of practice. I would say 100 if it did not sound too radical, and if I did not know that some of our friends in some of the technical shops would claim to do the whole job in one hour. I am not talking technical shops this time, I am talking trade schools. I believe that the man who knows the machinist's trade will cut a V-thread without a conscious thought, except for its size. A trade is something less than 10 per cent. instruction, and something more than 90 per cent. practice. If the practice is under the eye of a man who knows his business, it will be more efficient, immensely so, but it will not be teaching from the professional educator's point of view.

Now let us look at the attitude of the workmen toward trade schools. In Massachusetts socialism is seldom heard of, but the socialistic microbe has itself well rooted. The workmen say that they will have nothing to do with any school not under State control. They also demur at the selling of the product of the trade school. The manufacturers are in a rather apathetic mood. They would be glad to try the boys that graduate from these schools; they will even agree to drop off more or less, usually less, of their apprenticeship course for such boys. The general taxpayer has not yet had a chance to say much about it, but it is as sure as death and taxes that if he is called on to pay for the materials necessary for the training of a thousand boys in the machinist's trade, only to see the product scrapped, he will sit up and take notice. The general public outnumbers the employers and employees in any trade; and there you are.

I believe that it will be accepted by everyone that if there were no economic waste we all might either work fewer hours, or else get more for our labor. The question is, how can we avoid this particular waste with justice to everyone?

My suggestions are as follows, written with special reference to the machinist's trade, which presents more difficulties than any other: First, the school shop must produce its own equipment after the start. That is, it must consume as much as possible of its product. Second, the balance of the product must be of some kind whose retail value is easily determined. The various associations of manufacturers make this possible, barring the question of quality. That *must* be taken care of by the school, no matter what the size of the scrap heap. Third, the full retail price of the goods must be paid by the consumer. Fourth, the school must be to no expense to sell its product. It must auction it off to the highest bidder, as often as enough accumulates to make a sale that will attract bidders. The purchaser must give a bond not to sell it to the consumer at less than the established price. If it gives purchasers secret rebates there must be heavy penalties. Fifth, no expense should be incurred for designs. If the director of such a school cannot design staple goods, get someone else.

Under these methods the real cost of selling will be as low as it is possible to get it; the goods will enter the regular market at the regular price; they will have to stand comparison with the regular goods. If they are inferior they cannot find a purchaser at all; which is right. If they are superior they will simply command a premium. Is there any element of unfairness about this, and is there anything impossible about it?

Fitchburg, Mass. ENTROPY.

"Proper Training for Engineers"

I notice an article, on page 248, under "Proper Shop Training for Engineers," in which Entropy gets on his "corked boots," as we Westerners say, and attempts to walk all over Mr. Cordullo. I am not going to take this up to help Mr. Cordullo but I do claim a place as one of those nine men out of every ten to whom Entropy gives himself credit for being contrary-minded.

Some years ago when I was carrying on some boiler work for a company, I was informed by a first-class machinist that there was nothing to the boilermaker's trade, and that any man with an old piece of sheet iron and a few rivets could repair boilers. Now a man with two boiler crews on his hands on repair work, and rush work at that, has not much time to let such things bother him, and as I considered it was a drive at me, I just laughed and went on. I have heard similar comments from others as to the blacksmith's trade, but I just looked on in pity for the ignorance of the commentor of the subject of which he spoke, thinking over in my own mind a few of the little simple every-day jobs I would like to hand him and watch him proceed.

But Entropy caps the climax when he asserts in his article that all there is to the machinist trade is to "push a tool up to the work or the work up to the tool." I have learned all three of these trades and I did not learn them chasing a pigskin either, and have no medals, cups, ribbons, etc.

If I were engaged in the busy affairs of some large plant now, as I have been in the past, and should read Entropy's article, it would have been highly amusing to me, but situated as I am now at the head of the mechanical end of a Western college, which has for its object the training of practical engineers, I feel it my duty to say a word in behalf of those of us who are earnestly endeavoring to make the practical part of an engineer's education a success which, in my opinion, in the past has not been so. There are several points in Entropy's article which I do not consider well taken, and the principal one is, that of obedience to a teacher's instruction. He says if he was going to send a boy to a university (or as I take it, an engineering school), his advice to him would be to disobey orders and proceed by his own methods. Just here is where he falls down. He quotes James Russell Lowell as saying "one thorn of experience is worth a whole wilderness of warning," and I think he might possibly apply this to his case in the instruction line. I would

like to run him a race for a year and give him all of my students that seek to follow their own ideas of doing things, and let me take those who are willing to submit themselves to my methods of instruction and see who gets the cup. In other words, if I did not consider myself better qualified to lay down the course of instruction than my students, I would turn it over to them and go down into the Santa Clara valley and *scab* on the prune pickers, or some other equally as terrible a thing.

Entropy goes on at great length to explain the beds of roses in which the students of today are rocked to sleep. Now if he will place the boy that he is interested in in my department, I will take a solemn vow that he will not have to disobey every order, or lie awake nights to keep himself in trouble during his shop periods; just leave that to me. And so I might go on and point out several other things that do not coincide with my experience as an instructor, but my object in writing this is to call the attention of Entropy and others, who are interested in the education of engineers, to two things. The first is, "the importance of age of an engineering student," and the second, "the difference between the manual-training system of instruction and that of practical training for engineers."

The manual-training schools (trade schools come under this head as well) have for their object the training of the hands, while the practical departments of an engineering school have, or should have, for their object the training of the mind. This is an age when people want to be shown, not told about things. Entropy made no new discovery when he found out that it was impossible to make a pattern-maker in three weeks, or a foundryman in a week and a half, or a blacksmith in a week, but even this amount of time spent in the different departments, supplementing as they must (to be a success), well and carefully prepared lectures by a practical (not a theoretical) instructor on the several subjects which each department is used to demonstrate, or, in other words, that each of the several practical departments are used as a foundation on which to start to build.

You might just as well try to teach astronomy without a telescope as to teach practical engineering without the mechanical laboratories. I can teach a student more about machine design from his experience in the laboratories than can ever be taught from instruction papers, simply because he has had the vital points that enter into the design, such as the methods of working the different metals, the most convenient forms for molding, the effect of unequal contraction in the cooling of castings of unequal cross-section, etc. All these things can and must be brought up and demonstrated and proved beyond a doubt that they do exist before the student is eligible to any farther instruction. Then when he is convinced of these difficulties, we are ready to go in search of *the* methods, not *my* methods for correcting them. My plan for doing this is to take my students, who are really interested, with me and visit the large shops of our cities and observe their different methods of accomplishing these ends, and then in the class room we talk it all over and see which we will adopt as what we consider the best plan.

In the teaching of the properties of metals, the effect of heat, to explain the strains that are set up in steel by working it, the principles involved in hardening and tempering, and even in explaining the processes by which steel is refined, the forge shop is indispensable.

It is not sufficient to tell the student that the valuable feature of tungsten steel for lathe tools is hot hardness; he wants to test it out, or at least, I want him to, and here again the heating and forging is necessary. When a salesman comes along and wants to sell his high-speed steel for about one-half what we are paying and claims everything for it, it is not enough to tell the student that one contains tungsten as the element to which we are indebted for the liberty to give it the high-heat treatment and the other carries molybdenum as a substitute, and the only way to demonstrate this fully is in the forge shops. Such experience as this has cost my employers in the past large sums of money, and those of us who have come up in the shops along with the modern high-speed steels necessarily had to learn these things by experience, and I can see no reason why the young mechanic of today should not take advantage of our experience in the past.

The Machine Shop

Here, as in the other practical departments, I find a foundation upon which to teach mechanical principles which I believe has no equal. Laying aside the all-important feature of "pushing the tool up to the work, or the work up to the tool" on which Entropy places so much stress, for this comes more properly under the study of properties of metals, I find a basis for dozens of lectures on mechanical principles such as reverse mechanism, transmission of motion by various means, the cone friction, different forms of screws, their proper use, etc. To be sure, these principles are not always carried to perfection, but the shop furnishes the basis, and as I have stated before, we go out among the different enterprises of our cities and see the different principles in their most nearly perfected state. It is not necessary for me to go into detail as to the best methods of instructing pupils, but I can assure you that my ideas have been greatly changed and enlarged by nearly two years of experience along the teaching line, and I think enough has been said to let Entropy and other readers know that it is not a question as to whether the practical departments of our universities are worthy of a place or not, but only a question as to the best methods of handling them.

Oakland, Cal. Ira F. Martin.

Grinding without Wheel Traverse

I was much interested in reading Mr. Norton's article on page 451, particularly as this article describes the incidental, but very interesting grinding chips or ribbons first produced while doing some very heavy grinding on a Landis grinder over two years ago, and described and illustrated at that time. I say incidental because these chips were produced by accident and were not the result of any carefully extended experiments, and perhaps the way they happened to be discovered will be of interest. While doing some heavy roughing and the wheel becoming glazed, the operator, an inexperienced hand, thinking it was not cutting properly threw the belt to a higher speed, which ran up to considerably over 6000 feet; the foreman noting the occurrence went to examine the work and noticed a slight formation or the beginning of the ribbons, and after continuing the operation then produced one of the coils which has aroused so much comment. It was recognized at the time that these ribbons were a sort of freak of nature, but this method of reducing stock by sinking straight in without traverse during the grinding operation, was so successful it has been continued to this day.

This article was perhaps rather misleading, as it seems to indicate that the chips were regularly made during this operation; while as a matter of fact the chips were only an accident. But this method of grinding, by sinking straight in without traverse, was no accident. In Mr. Norton's article he claims this to be an abnormal and unscientific method of grinding, and as he shows figures to prove it, it is possibly a fair answer to say that the results stated in this article, which were obtained at that time and can be obtained today on a stiff machine, are abnormal as compared with the results he described.

For 1¾ cubic inches metal removed per minute is rather abnormal as compared with 2.34 cubic inches in 10 minutes or even 2¾ cubic inches in 1½ minutes as he produces by the most scientific methods.

This operation and method of grinding is carried on in the same way today, for the same reasons as given at the time—it reduces stock faster than is possible in any other way known, and it eliminates the loss in cracking which is bound to occur in a hardened spindle with a wide difference in two diameters, when hardened after the end is reduced to the small diameter. The ribbons are turned

out incidentally whenever some visitor wants to see one made, but it is not every operator who can make one, as in order to do it he must throw overboard his preconceived ideas of grinding practice; let his wheel become glazed, run up the speed, and slow down the work speed, and take a very heavy cut.

The make of wheel has no bearing on the operation, and though a Norton wheel has not been tried for this particular job I am satisfied that it can be made to tear off stock in this manner at the rate of 1¾ cubic inches per minute; and though this way may not be a scientific method it has the virtue of being faster than any known method, the only requisite being a machine with sufficient power and weight to back it up. H. F. NOYES.

Waynesboro, Penn.

Treating High-speed Steel

Under the heading "The Treatment of High-speed Steel," by Ethan Viall on page 314 of the AMERICAN MACHINIST, the directions for D. S. W. steel are not given and I take the liberty of giving them as advocated by the makers, Seeholm & Deickstahl, Ltd., Sheffield, England.

Where machinery is not powerful enough or the work not heavy enough for Capital high-speed steel D. S. W. steel is highly recommended. It is an excellent finishing steel. To forge gradually heat the metal well through before forging the first time and hammer at a bright red heat, which is about 1650 degrees Fahrenheit, then harden in water or oil at a bright cherry red or 1500 degrees Fahrenheit. Harden thoroughly and do not let down or temper afterward.

The directions for Capital high-speed steel by the same makers are to forge heat the steel very slowly to a full bright red or 1750 degrees Fahrenheit and then forge either by hand or under the power hammer. Do not continue forging when colder than a full cherry red or 1500 degrees Fahrenheit or strains will be set up. After forging allow the steel to cool slowly and then grind to shape.

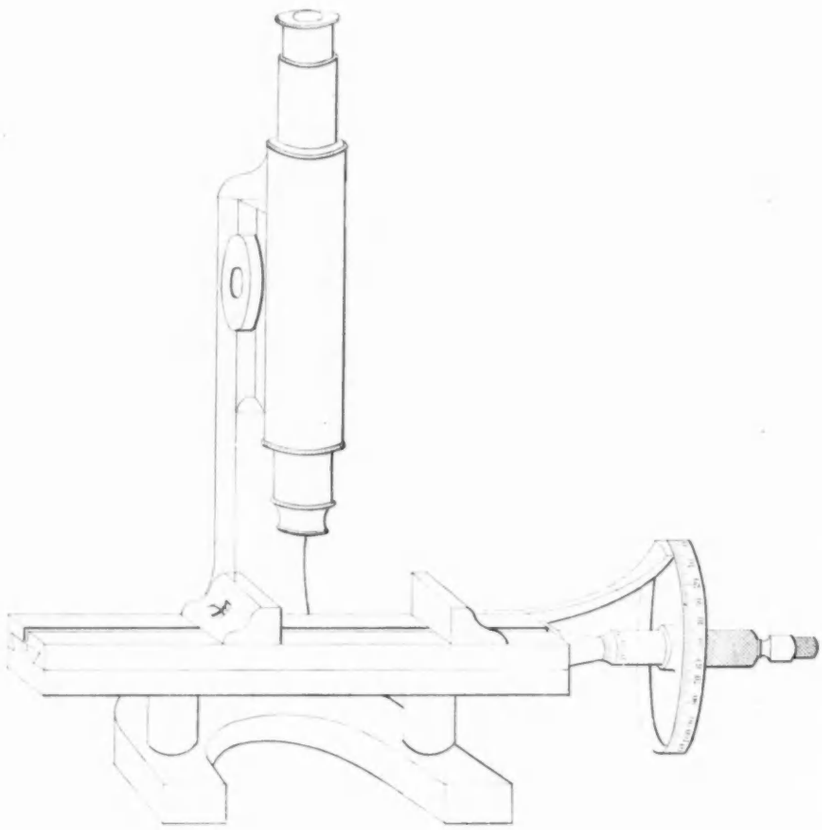
Hardening in a blast is specially recommended and not as Ethan Viall has it, "An air blast may be used instead of oil." To do this heat the *point* of the tool very slowly to a full bright red. Then more quickly to a full white or 2100 degrees Fahrenheit and cool instantly in a strong cold blast. This steel cannot be spoiled by overheating if not left to soak.

To oil harden, heat the point very slowly to a full white or 2100 degrees Fahrenheit. Allow it to cool to a full red or 1600 degrees Fahrenheit and plunge the whole tool into oil; cotton seed oil is preferred and the supply should be ample. After hardening grind carefully on a wet sandstone. Do not draw or let down by tempering.

London, Eng. R. LANGLIN.

Acute Vision in Machine-shop Measurements

The article under this title by Mr. Alvord on page 832, Vol. 30, Part 2, is quite interesting, and something not frequently spoken of, because most mechanics try to take good care of their eyes. I believe that a man can train his eye to measure reasonably accurately by a scale, but when it comes to measure hundredths, or rather to subdivide hundredths, without a glass it is an unnecessary strain on the eyes. A pair of good eyes is too valuable to be used in that way, especially with the poor light that many of the shops have.



COMPOUND MICROSCOPE MEASURING TO THE TEN-THOUSANDTH PART OF AN INCH

Where a person uses spring calipers and can hold them up to the light the eye has a sharp outline by which to guide it, can easily detect 0.001 inch and soon becomes expert in noting slight variations; but when a person looks at the graduations on an ordinary scale where the lines themselves have width it is a difficult matter to detect slight variations. I do not think that the average mechanic would be able to train his eye to do so.

It has been proved over and over again that the sense of feeling is finer than the best pair of eyes that ever saw daylight.

In a small shop that I worked in the boss and I each had very good eyesight. We would often test our eyes and I never found that we both saw the same object in the same way; for instance, the setting of an ordinary protractor and testing the angle will show how near the eyes will get the marks to line up, or setting a universal chuck on the planer or milling machine and then using the test indicator to prove it. Even when a glass was used we found that we seldom got absolutely the same setting. Another test was the measuring instrument we made as shown in Fig. 1. It consists of a compound microscope such as is used in laboratories and has the cross hairs. The bottom support for objects is removed and a slide with a micrometer screw and dial fastened in its place. A small spring chuck is fastened on the slide and objects to be measured are held by the pressure of the spring; the stationary end of the chuck has a rack and pawl so that it can be set at the extreme end of the slide, or anywhere else according to the length of the object to be measured.

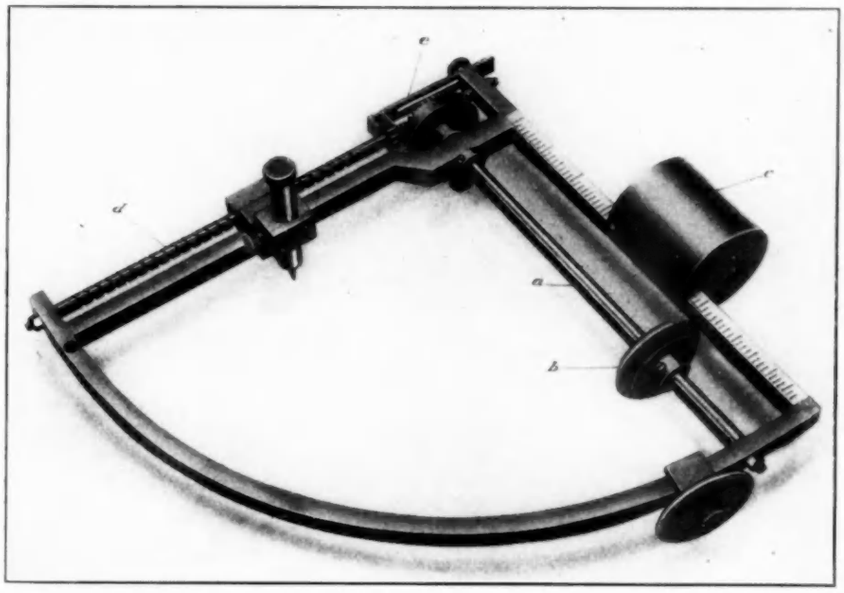
This instrument was used in a type foundry to measure to the ten-thousandth part of an inch; the dial is graduated into 250 divisions. The matrix or mold in which the type is cast has a specified depth and the sides are beveled. Now the matrix is cut by a machine; in order to measure the hight of the face of the type, which is at the bottom of the mold a cast is taken and then the face of the type it-

self is measured. With this instrument it can be measured without making a cast in the mold. It requires good eyesight to line up the cross hair with the edges to be measured and we found that by measuring the same matrix each in turn, we would get different readings and yet when each measured the same matrix several times we would each get the same reading; this shows that our visions were not the same.

Minneapolis, Minn. A. J. DeLille.

An Instrument for Generating Spiral Curves

Some time ago there was published in the American Machinist a description of an instrument, for generating curves of varying throws, which was quite interesting, and suggests to me to send the following description of an instrument having the same purpose, but of a totally different design. It is original with me.



AN INSTRUMENT FOR GENERATING SPIRAL CURVES

As the cut shows it consists of a frame in the shape of a quadrant, which supports the various working parts. Underneath the offset part of the frame is secured a foot having at its end a small pin point around which the instrument is revolved. Passing through this same part of the frame, is a splined shaft *a* directly central over the pin point, and pivoted at its outer end on a small V-pointed screw held in place by a checknut. Sliding on this shaft is the driving wheel *b*, which is rubber tired to grip the surface on which it runs. It is held down by the weight *c* which can be shifted on the frame so as to exert its pressure wherever the wheel happens to be.

Mounted on the inner end of the driving shaft are two crown gears of 48 pitch; one has 45 teeth and the other 30 teeth; the smaller is inside of and concentric with the larger. In the cut only the outer one is visible. Meshing into these crown gears is a 15-tooth pinion, which is keyed on the coarse pitch screw *d* but is free to slide thereon. It is held in position by the slotted fork *e;* the object of this construction is a greater range, also by shifting the pinion to opposite sides of the driving gears, either a right- or left-hand curve is produced without changing the direction of rotation of the instrument about its center.

Sliding on the straight part of the frame is a traveling nut engaging the screw, and adapted at its inner end to carry a pencil point or other scribing device. The line of travel is radial to the center point. From this it will be seen that a three-point bearing is secured, which insures that all working points are in contact with the surface upon which the instrument rests. An additional advantage is gained in the ability to raise the pencil and produce dotted lines on a drawing without interfering in any way with the working of the instrument.

Outside of the frame will be seen a small idler wheel *f* near the outer end of the shaft *a*. This idler wheel is exactly 1 inch in diameter. Its purpose is to maintain a constant diameter of the rubber-tired driving wheel, which is slightly larger than 1 inch to allow for compression. This driving wheel can be secured on the shaft *a* by means of a small set-screw in its hub; its position is determined by the scale shown, the first mark is on the center, and therefore zero. To set the wheel for a given throw the mark on the scale is brought in line with the center of the rubber rim.

Supposing we wish to describe a spiral of ½ inch throw in a complete revolution. We proceed by setting the driving wheel so that the 1-inch graduation mark of the scale, comes in line with the center of the rim. This will cause the wheel to describe a circular path 2 inches in diameter, and since its diameter and circumference are directly proportioned to the diameter and circumference of the path which it describes, we know that our driving wheel will make two revolutions in its course around the center. Now loosening the slotted fork *l* we slide the pinion on its shaft so that it meshes with the inner crown gear, which having a ratio of 2 to 1 with the pinion will cause the pinion and screw to make four revolutions to the two which the driving wheel makes. The screw, however, is of ⅛ inch lead and will cause the nut holding the scribing instrument to travel $4 \times \frac{1}{8}$ or ½ inch.

Now if we wished to get a throw of ¾ inch we would simply slide the pinion into mesh with the larger crown gear having a ratio of 3 to 1 with the pinion, and the screw would then make six revolutions to the two of the driving wheel or $6 \times \frac{1}{8} = \frac{3}{4}$ inch. The instrument shown has a range of throws from ⅛ inch to 3 inches, with a maximum and minimum radius of 4½ and 1½ inches respectively. It was designed to lay out cams of an even increase or rise such as are used on Brown & Sharpe automatic screw machines and proved satisfactory.

New York City. L. W. Charles.

Unnecessary Calls for Assistance from Machine Purchasers

We are particularly interested in the article, at page 560, by Jas. N. Heald, on "Some Grinding Machine Troubles and What Causes Them." We hasten to assure Mr. Heald that his troubles do not arise from the fact that he is building grinding machines. We believe that the manufacturers of many different kinds of machines have just the same troubles. As manufacturers of pipe-threading machinery, we have made a number of useless trips, which are very similar to those described in the article. This question is one which we think is of vital interest to all machine-tool builders, and it occurs to us that possibly a full and free discussion of the question in the columns of your paper would cause the foremen and superintendents of a large number of shops to think the matter over and be less hasty in their calls for help.

We have found that the majority of the complaints come from large shops, where competent foremen are employed. We can only explain it by supposing that his many duties prevent the foreman from spending any great amount of time in trying to locate the trouble, and he simply sends to the factory for a man to come and find out what is wrong, whereas in

the small shop, the operator or foreman has a little more pride in his personal ability and tries to find out himself what is wrong.

We have found that the majority of such needless complaints come from the East, i.e., east of Buffalo and Pittsburg, and it cannot be explained by saying that we have more machines in the East than in the West, because they are very evenly divided. Is it because the users are near to the factory and, consequently, think it not much trouble to send someone to help them out?

We will cite one instance which is typical: We sent one of our small machines, which threads pipe from ¼ inch to 2 inches, to one of the largest manufacturing establishments in the East. After using it for six weeks, they sent word to us that they could not make the machine do good work. We sent a man to investigate, and he found that they were running the machine on the next to the lowest speed, which was suitable for 1½ or 2-inch pipe, but were trying to cut ⅜ pipe, and, naturally, did not get very good results. During the six weeks use of the machine, they had been cutting other sizes of pipe, but the operator stated that he had never changed the speed of the machine during that time, and when asked why, said he did not know how. The machine was built with a single-pulley drive, but the changes in speed were very simply made and were apparent to anyone who would simply look at the gearing in the machine carefully. Strange to say, the foreman of the department is a very capable man. For some reason, however, he neglected this machine entirely. One would naturally think that natural curiosity would lead any operator to try and find out how to change the speeds on a machine.

We think there is no doubt that the expense and time which the manufacturer spends in straightening out such matters should properly be charged to the purchaser of the machine. It is not done, however, for the reason that manufacturers expect further favors from the purchasers, and are afraid that such charge would be held against them at the next purchase. If a free discussion of this matter in the AMERICAN MACHINIST could convince the users of machinery that the manufacturers would charge for such expense and insist upon being paid for it, there might be a diminution in the number of requests.

THE STOEVER FOUNDRY AND MANUFACTURING COMPANY.

Lebanon, Penn.

A Circular Forming-cutter Problem

Perhaps the following suggestion may help I. G. Owen to get the proper angle on his forming-cutter to make the 60-degree points on his pinion wire. His method, as described at page 443, seems rather crude as he suggests. Why does he go to the trouble to make a lay-out at all? If, in turning up his cutter, he will set his compound rest at an angle of 30 degrees with the center line, and then set the point of his cutting tool either ½ inch above or below the center, the cutting tool will do its own laying out, and produce a forming tool with a slightly hollowing bevel which will turn a straight-sided cone on the end of his pinion wire. If he turns his forming cutter in the ordinary way, with the lathe tool at the hight of the center, he will then have a straight bevel on the forming cutter that will, in theory at least, produce a slightly concave cone on the end of the pinion wire. This curve will be a portion of a hyperbola, or closely analogous to that, and the easiest way to eliminate it from the work where it is not wanted, is to introduce a similar curve of the opposite direction in the forming tool where it will do no harm. The curvature of the faces of the bevels may be so slight as to escape notice, but the scheme of setting the lathe tool as much above or below center as is the cutting edge of the forming tool when in use, will give the proper bevel to the cutter.

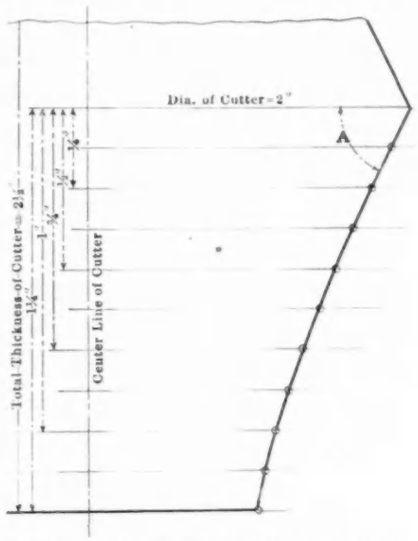


FIG. 5. A CIRCULAR FORMING-TOOL PROBLEM

Brooklyn, N. Y. WALTER GRIBBEN.

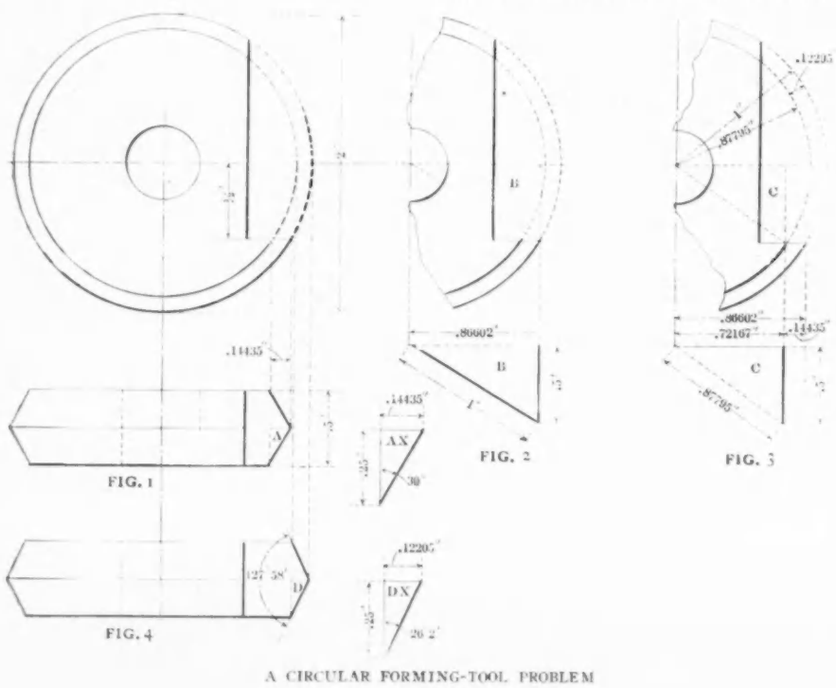
Referring to I. G. Owen's forming-cutter article, I wish to say that my practice in making such tools when the cutting edge is below center is to set the master tool the same amount below center when finishing the forming cutter. Although I have never had one to make which was cut below center as much as ½ inch, I have had good results with tools cut from 1/16 to ⅛ inch below.

Torrington, Conn. W. S. BARNES.

At page 443, I. G. Owen asks for a correct method of forming a circular tool for turning 60-degree points. The formed surface on the edge of the tool will evidently not be a conical surface. The proper form can easily be obtained by turning the blank with a tool set at an ankle of 60 degrees with the plane of the cutter blank, and with its cutting edge horizontal and ½ inch below the center of the blank. An equivalent rig could be arranged to grind the cutter after hardening. In the case given the arbor for the cutter should be located either below or above the wheel center a distance equal to ½ (1" + radius of emery wheel); the two spindles lying in vertical planes at an angle of 30 degrees.

Milwaukee, Wis. S. FARIS.

Here is a method of solving, by calculation I. G. Owen's cutter problem at page 443.



A CIRCULAR FORMING-TOOL PROBLEM

In order to see the several steps in the calculation clearly, I have taken the triangles out of the views to solve them.

To begin, a definite diameter and thickness of cutter must be settled on. In this case I take Mr. Owen's figures, 2 inches diameter, ½ inch thick, angle 30 degrees and cutting edge ½ inch below center.

The first dimension sought is the depth of the bevel, or, short side of triangle *A*, and *A X*, Fig. 1. Tan. 30 degrees multiplied by one-half the thickness of the cutter equals the depth of bevel on the cutting edge when ½ inch below the center. Tan. 30 degrees = 0.5774, and 0.5774 × 0.25 inch = 0.14435 inch = short side of triangle *A X*.

The next step is to obtain the length of the dotted side of triangle *B*, Fig. 2.

$$\sqrt{1^2 - 0.5^2} = 0.86602 =$$

horizontal distance from the center to the point of cutting edge. 0.86602 — 0.14435 = 0.72167 = one side of the triangle *C*, Fig. 3, and

$$\sqrt{0.72167^2 + 0.5^2} = 0.87795.$$

0.87795 inch is the radius from the center of the cutter to the bottom of the bevel, and 1 inch (one-half the diameter of cutter) — 0.87795 inch = 0.12205 inch = radial distance from point of cutting edge, to bottom of the bevel. This 0.12205 inch is the short side of triangle *D* and *D X*, Fig. 4.

0.12205 ÷ 0.25 = 0.4882 = tan. 26 degrees 2 minutes = angle of cutter with center line. The included angle between the opposite bevel faces of the cutter will of course be 2 (90 degrees — 26 degrees 2 minutes) = 127 degrees 56 minutes.

New Haven, Conn. B. S. FRANK.

[As pointed out by several contributors, the sides of the cutter for forming the cone point on the work will not be straight bevels when measured on the center line but instead will be slightly concaved. The curve is such that while the departure from a true bevel is negligible for a cutter of ordinary thickness, say up to ½ inch, the deviation from a straight line becomes more marked as the thickness of the cutter is increased. This is shown clearly in Fig. 5 which represents about double size, a portion of a cutter 2 inches in diameter and 2½ inches in width or thickness; the curved outline becoming a straight line at a 60-degree angle when the cutter is milled ½ inch below center. Lines drawn at intervals of ⅛ inch from the center of the width of the cutter, that is from the junction of the two beveled surfaces, represent various thicknesses of cutter and the change in the character of the curve from one line to the next is quite marked. It is obvious that when computing the angle by the method given above or by any similar process, the thickness of the cutter must have an important bearing upon the result; the angle measured at *A*, Fig. 5, increasing with the increased thickness.—ED.]

Split Rings for Preventing Leakage in Centrifugal Pumps

I noticed on page 322 of the AMERICAN MACHINIST an article by C. W. Clifford advising the use of split rings to prevent leaking around the suction of inclosed runners in centrifugal pumps. The following is my experience with split rings for a similar purpose on an experimental, two-stage, deep-well, turbine pump, about five months ago:

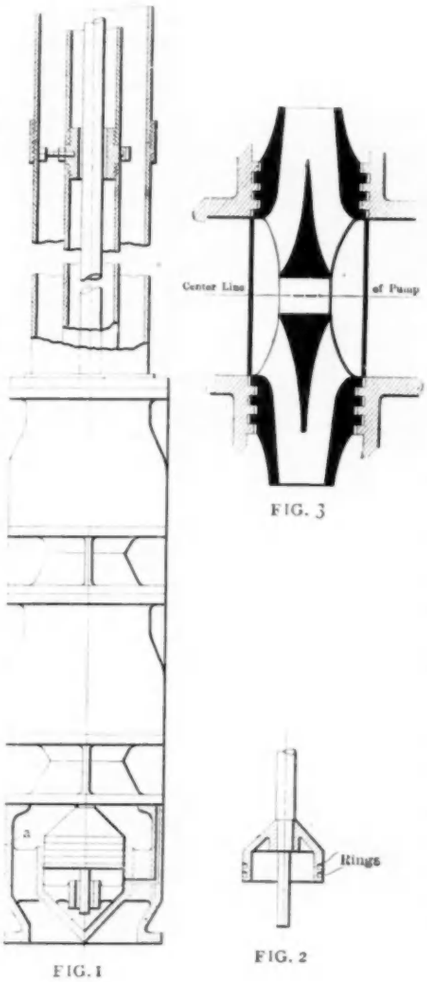


FIG. 1 FIG. 2 FIG. 3

SPLIT RINGS TO PREVENT LEAKAGE AROUND SUCTION

This turbine pump had what are called open runners. The shaft was supported at the top by a heavy ball-bearing thrust and was guided at 8-foot intervals by bearings that were inclosed in a 4-inch pipe, which was concentric with an 8-inch pipe that held the weight of the pump and also served as the discharge pipe.

Fig. 1 shows the arrangement of the pipes, bearings and other details. At *a* is a water step which is used to relieve the ball bearing of most of its load. This is very essential for high speeds. As will be seen this step consisted of a plunger rotating in a cylinder. To prevent undue leakage past the plunger various schemes were tried, one of which was the ring method described by Mr. Clifford.

The rings used in this pump were two in number and were made after the most approved method; first turned, then split and returned to size. They were fitted into the plunger by a skilled mechanic. Fig. 2 shows the plunger and rings.

When tested the pump showed poor in efficiency. A water step was then rigged up with only water grooves to prevent leakage. When tested this time the pump showed an improvement in efficiency of 15 per cent. This method was considered good enough and the tests were continued, using this step.

This plunger had a 1/32-inch clearance, which is the amount allowed on medium-sized pumps by the leading centrifugal-pump manufacturers. The table gives the usual practice.

Capacity in Gallons per Minute.	Clearance.
25 - 275	1/64 inch.
275 - 2500	1/32 inch.
2500 - 100,000	1/16 inch.

If one stops to carefully consider these two methods, he readily comprehends why the groove method is the more efficient when properly constructed. For instance, when a pump with the water groove packing is running a film of water is constantly circulating between the two rubbing surfaces. On the other hand, with the ring method, the ring presses out on the bearing surface with a force sufficient to prevent the water from lubricating the joint. As all engineers know, the friction of water on a machined surface is a great deal less than the friction caused by one machined surface moving upon another; it follows that the ring method causes the more friction. That Mr. Clifford found better efficiency in the ring method shows that his clearance was too great.

If any reader wishes to use a more effective method, but one which is a trifle more expensive, I suggest that he try that shown in Fig. 3. The theory of this packing method is based on the fact that a loss in pressure is experienced by water passing through short-radius elbows. By having a sufficient number of such elbows the pressure can be greatly reduced. Referring to Fig. 3, it will be seen that the short-radius elbows are obtained by turning concentric rings in the runner and cover.

JOHN B. SPERRY.

Aurora, Ill.

AMERICAN MACHINIST

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Use Your System or Kill It

A recent incident brought to our attention in a striking manner the careless way in which some factory systems are used, or rather misused. We were visiting a large machine shop, one which was apparently in a prosperous condition. The superintendent was conducting us about and pointing out interesting features in the equipment, methods and product.

In dwelling upon some of the salient features of his factory system he stated that all of the castings from the foundry were carefully inspected before entering the machine shop. Each lot of castings was accompanied by an order tag. On this tag was a specific place for the signature of the casting-inspector. The superintendent remarked, "no castings are allowed in the machine shop if their tag does not bear the signature of the casting-inspector to indicate that they are proper castings to be machined. Let us step over to this pile of castings and I will show you how the system works." We stepped over to one corner of the shop which was used for storage. The superintendent picked up the tag nearest to him in order to show the signature of the casting-inspector. No signature was visible. With an unintelligible exclamation he hastily examined another tag; still no signature; then a third, then a fourth, and so on until he had been through about one-half of the work tags in the pile, before he came to one which bore the required signature. He attempted to explain and to offer excuses, but to little purpose. The clean-cut statement which he had made in regard to the excellent working of this detail of his system, the large number of tags he had turned over bearing no signature whatever, and the look of chagrin and air of embarrassment which came over him when he realized that his much vaunted detail was lamentably lacking, produced a situation which would have been nothing but ludicrous had we not realized the lamentable fact that this was by no means an exceptional case.

Too often a system is worked out with the greatest care and launched with every hope of success only to degenerate in a short time into a mere form, which is carried out only when someone happens to think of it. A system has no life within itself. There is nothing to keep it going when the personal interest and attention of those responsible are withdrawn. While we all believe the familiar maxim that "a half loaf is better than none" we should also recognize that *a half system is worse than none.* The very fact that a certain detail of factory system exists presupposes that it was started to meet some factory need, to serve some good purpose. But if conditions develop so that the system falls into disuse, or is only half carried out, it is much better to do away with it entirely than to keep it going in a mutilated condition. In the words of our title, "Use your system or kill it."

A Factor in Keeping Machine Tools Sold

"Do you realize how careful the ——— people are (mentioning a prominent firm of machine-tool builders) to make sure that every new machine which they send out is put into successful operation, and is satisfactory to the purchaser?" This question was put to us by the proprietor of a machine shop as we were chatting with him in his private office.

Continuing, he said: "I recently purchased a new machine from them. As soon as it was delivered they sent an expert operator to adjust it and to get it going. He was here a week or ten days. When he left, the machine was working all right; at least I was satisfied. He has been gone a little over a week and, now, in this morning's mail I get a letter from his firm stating that they are sending, by prepaid express and without charge, a few parts to replace some that their operator reported as being defective. They describe the parts and I have looked over the machine and can see the minor defects which they are endeavoring to correct. They are trivial, such as most machine-building firms would entirely overlook, or would consider as 'good enough.' Not so with this firm; they want to have that machine right. I have bought machines from them before, and have always received treatment animated by the same broad-minded spirit. From what others have told me I know that my experience is not exceptional."

It is probable that this policy is one of the reasons why this particular firm has earned well-merited success. We are fond of speaking of machines as "children of the brain" or "children of the hands;" but do we carry out all that this figure of speech implies? When a child leaves its home to go among strangers and show what it can do, is parental interest dropped as soon as the child crosses the threshold of the home? By no means! Should a machine-building firm lose all interest in its product as soon as a machine is pushed across the threshold of a freight-car door? By no means! Each machine should be followed with watchful care until it is successfully at work in the shop of the purchaser.

A Cupola Demonstration

Arrangements have been made by J. de Clercy, agent for the Société Anonyme d'Exploitation des Brevets Cubilot A. Baillot, of Montreal, Canada, to exhibit a cupola in operation in connection with the convention of the American Foundry

men's Association and the exhibit of the Foundry Supply Association to be held in Toronto June 8-12. This cupola is now being erected in a temporary building adjoining Machinery Hall. The blast for the cupola will be furnished by one of the new Sturtevant turbine blowers operated by a steam turbine. A novel feature of the installation is that the exhibitors expect to put on the blast in the morning and to pour iron for an hour and then to bank the cupola for two hours during lunch time. Later it will be running in the afternoon for two hours or more. The principal point to be demonstrated is the possibility of furnishing a small amount of iron continuously for a long period with only a moderate consumption of fuel and also the possibility of starting and stopping the cupola at will. They guarantee to pour very thin light work and arrangements have already been made for pouring a large number of molds for light delicate castings. This demonstration will be unique and of great interest to many foundrymen.

National Architectural Exposition

An exhibition that will be somewhat of a departure from the regular form of such affairs will be held during the week of September 14-19, at Madison Square Garden, New York City. From a report of Alfred Chasseaud, General Manager, 1 Madison avenue, New York City, the exhibition is to be a combination of all departments in architecture, engineering, painting and sculpture, and will be the first exhibition of its kind held in this country. The exposition, carried out upon the lines intended by the management, should possess many features of novelty and utility. Up-to-date effects in engineering, construction and equipment are promised as a special feature in the large and varied program.

New Publications

TABLES OF THE PROPERTIES OF SATURATED STEAM AND OTHER VAPORS AND TEMPERATURE-ENTROPY TABLES. By Cecil H. Peabody. Seventh edition; rewritten. 131 6x9-inch pages. John Wiley & Sons, New York. Price, $1.

Professor Peabody's well-known tables were calculated 20 years ago, to accompany his "Thermodynamics of the Steam Engine," and are now recalculated to include the information made available by the experimental investigations of Callendar, Barnes, Knoblauch, Jakob, Thomas and others. To the tables for saturated steam have been added columns of the entropy due to vaporization, and the table in metric units has been made into a conversion table by printing the metric and British units in parallel columns. The most important addition to the volume is a temperature-entropy table, by which the solution of adiabatic and other problems is much facilitated.

BULLETINS OF THE ENGINEERING EXPERIMENT STATION OF THE UNIVERSITY OF ILLINOIS. Vol. II. 435 6x9-inch pages, with numerous illustrations. Published by the University at Urbana, Ill.

The various bulletins giving the results of original investigation at the University of Illinois, which have been published since November, 1906, are here grouped together in a bound volume. The list includes bulletins Nos. 9 to 17 inclusive, and covers the extension of the Dewey decimal system of classification to engineering architecture and building; tests of concrete beams and columns; the effect of scale on the transmission of heat through locomotive-boiler tubes; the burning of Illinois coal without smoke; a study of roof trusses and the weathering of coal. Some of these bulletins have already been noted in our columns as they appeared, and we can only repeat that they are of the highest order of value. The work done at this experiment station is of a kind of which altogether too little is done in this country and it reflects large credit upon all concerned.

PROFIT MAKING IN SHOP AND FACTORY MANAGEMENT. By Charles U. Carpenter. 146 5¾x8½-inch pages. *The Engineering Magazine*, New York City. Price, $2.

This is a compilation of a series of articles on factory organization and management that appeared in the serial form in the *Engineering Magazine* during the year 1907. The defects of the usual factory organization and methods are classified as follows:

"1. Defects of factory organization, dealing with the superintendent, the foremen, the job bosses, and the workmen, and the usual methods of management.

"2. Defects of systems and methods of manufacturing.

"3. Defects of sales organization and executive control."

These defects may be called the text of the book, for the succeeding chapters suggest systems, arrangements and methods to control, correct or eliminate them from the factory or shop. The use of "committee system," "factory reports" and "standard times" are dwelt upon with marked emphasis. Striking illustrations of results which were obtained in the author's own experience are frequently given. Not only are the production departments "brought upon the carpet," but the sales organization and executive department as well. The author's personal use of the systems which he describes and advocates, coupled with his wide experience in factory management give a vigor and animation to the style far different from that found in the usual work on systems and methods.

Personal*

J. W. Meachem, president of the New Process Rawhide Company, has been elected president of the Chamber of Commerce, Syracuse, N. Y., in which city his company is located.

Harold J. Moore, formerly connected with the engineering firm of Dodge & Day, has recently become associated with the Bridgeport Brass Company, Bridgeport, Conn., in the capacity of production engineer.

Horace H. Lane, for a number of years with the engineering firm of Westinghouse, Church, Kerr Company has established an office in the Penobscot building, Detroit, Ill., where he will engage in a general engineering and construction business.

Paul Armstrong, of the Armstrong Bros. Tool Company, Chicago, Ill., sailed for an extended business trip abroad. His itinerary includes England, Scotland and all points on the continent where his company has agencies established, and it is expected will consume about four months.

W. H. Hansell, formerly chief mechanical engineer of the Standard Roller Bearing Company, Philadelphia, has become manager of the New York territory for the Chapman Roller Bearing Company, of Boston, with headquarters at Hudson Terminals building, New York City.

Professor Ira O. Baker, for six years connected with the Department of Civil Engineering of the University of Illinois, has been granted leave of absence for one year from July 1, 1908, during which time it is understood he will devote himself to a revision of his book on "Masonry Construction." During his absence Professor Baker's duties will be assumed by Prof. J. P. Brooks.

Convention of the A. F. A.

Arrangements for the American Foundrymen's Association and exhibit of the Foundry Supply Association, to be held in Toronto, June 8 to 12, announcement of which has already been made in our columns, are reported as making satisfactory progress. The buildings are taking on an exhibition appearance and it is expected that by the time the convention is called everything will be ready for successful operation.

Arthur Koppel Dead

Arthur Koppel, head of the Arthur Koppel Company, whose business in light railway construction and supplies has become a world-wide one, died at Baden Baden, Germany. Mr. Koppel was 56 years old, and his plant at Koppel, Penn., near Pittsburg, gives employment to an immense number of men.

New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make It Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

A Large Special Universal Radial Drill

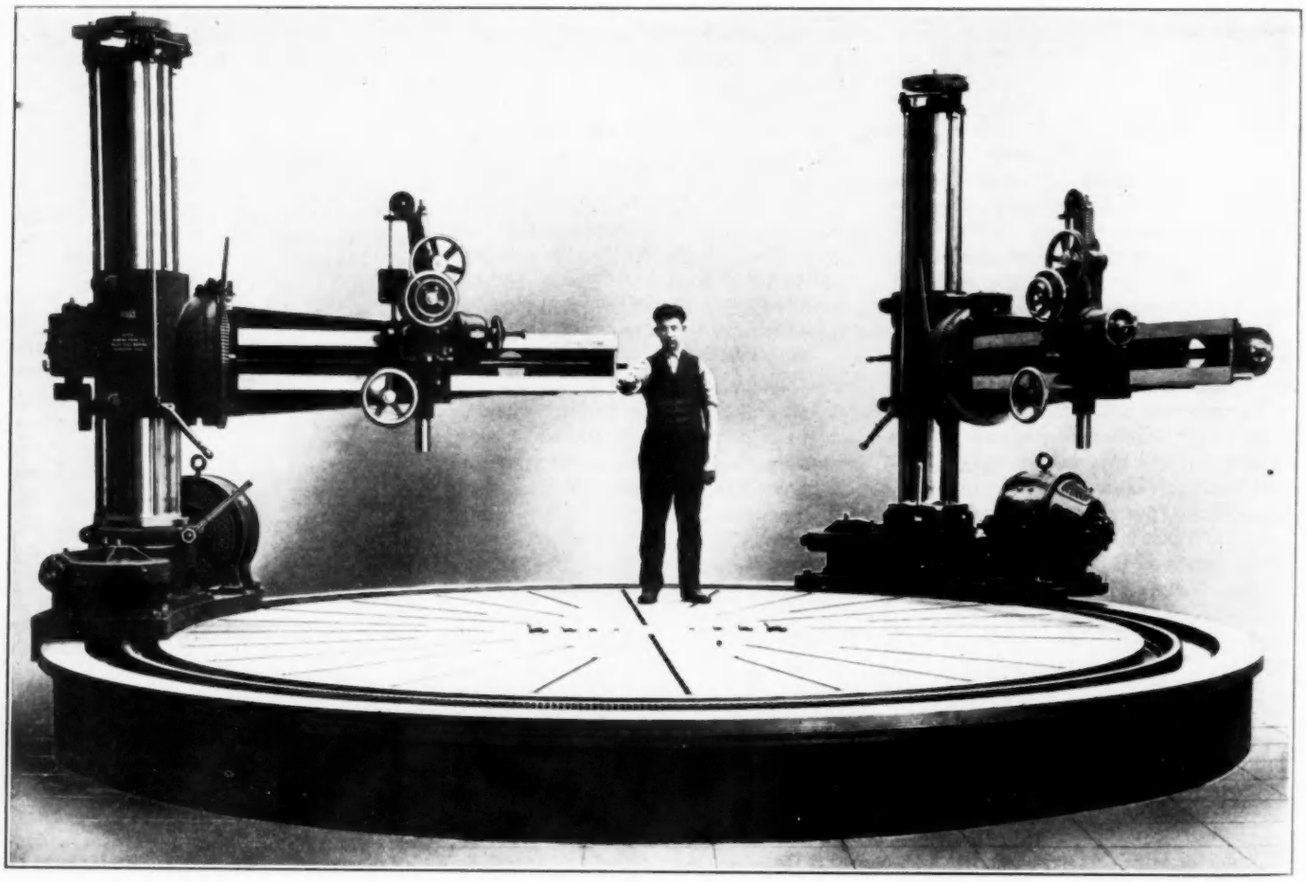
The accompanying illustration shows a 6-foot universal radial drill, which has recently been constructed by the Niles-Bement-Pond Company, for exportation. As will be noticed, there are two drills mounted on a single 20-foot round bedplate, and each drill is independent of the other. The power for each drill is provided by a 5-horse-power Westinghouse type "SA" motor.

The adoption of an interpole motor was decided upon to provide for a wide range of speed without mechanical speed-changing devices. The motor selected can be varied from 400 to 1600 revolutions per minute, and will deliver its full rated horse-power for twelve hours continuous service at any speed within its range.

The motor is used not only for driving the spindle, but by a special clutch may be made to move the column about the bedplate and bring it to any desired position. Either direction of traverse may be obtained by a reversing switch, which is not shown in the illustration.

The use of a variable-speed interpole motor of wide range permits the drills to be run at all times at their maximum speed, regardless of the size of hole to be drilled, as the speed of the motor may be varied by small steps to suit the work being done. To provide for the circular movement of the columns by mechanical drive would have been very difficult, if not impossible. By the individual electric motor the difficulties are overcome in the simplest manner.

As each drill column must move half way around the bedplate, an armored cable protects the wires connecting to the motor and supplies the necessary flexibility. The controllers for starting and governing the speed are mounted one on either side of the bedplate on a special frame, which also carries a double pole, double throw switch for reversing the direction of rotation of the motor.



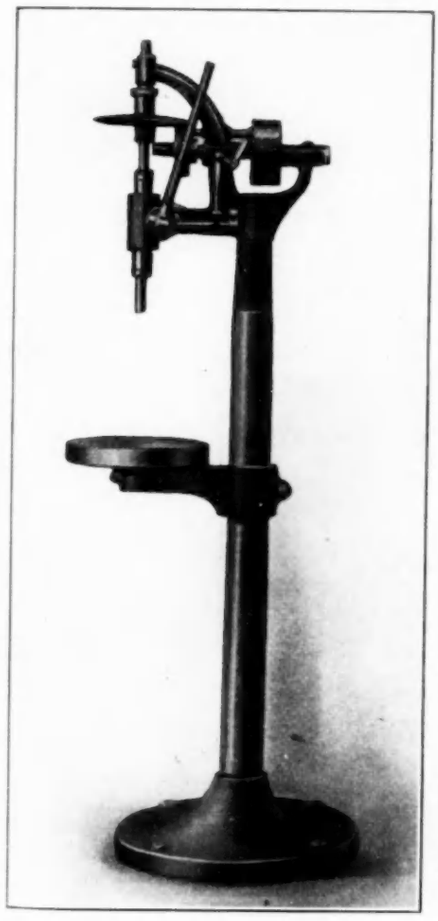
A LARGE SPECIAL RADIAL DRILL

A Friction-driven Sensitive Drill

This differs from the usual friction-driven drill in the way in which both the speed and feed are controlled by one handle. The belt drives the pulley directly over the center of the column, which in turn drives the horizontal shaft carrying the friction driver. In the position shown it is driving the drill at high speed, and to change it the lever is pulled to the side, which operates the small bell crank near the driving pulley by means of the horizontal shaft and the connection shown. These control the movement of the friction driver along the splined driving shaft. The driving friction is built up of paper

and the disk on the spindle is held in contact with it by a stiff spring.

The drill feed is obtained in the usual way by moving the lever forward, or downward, and if during the drilling operation it is found desirable to change the feed of the drill, all that is necessary is to give the lever a slight movement either one way or the other, without stopping the machine or making any other adjustment. The spindle mechanism is so constructed that when the feed lever is raised to the standing position the spindle stops automatically, which avoids running the drill when not in use. There is a ball-bearing thrust collar, the table is counterweighted, and a turret table, consisting of a spider swiveled in a vertical position on the platen arm can be furnished. If it is desired to use this as a vertical centering



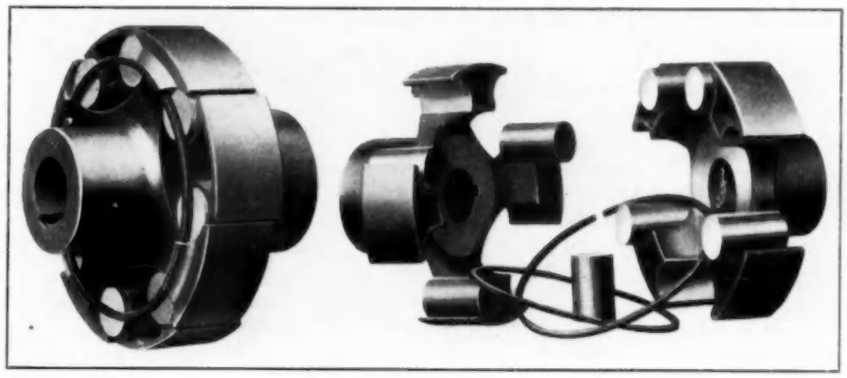
BRADFORD SENSITIVE DRILL

drill, a special vise is supplied for this purpose.

The machine has a capacity up to ½-inch drill, and will drill to the center of a 14-inch circle. The greatest distance from the spindle to the table is 30 inches, and the spindle movement 2¾ inches. The spindle is ⅞ inch in diameter and has a No. 1 Morse taper. This machine is built by the G. W. Fleming Company, Bradford, Penn., and is known as the Bradford drill.

Flexible Insulated Coupling

This flexible insulated coupling is manufactured by the R. D. Nuttall Company, Pittsburg, Penn., and consists of two interlocking spiders of cast iron which are insulated by solid rubber cylinders. The only other parts are two steel rings used to hold the rubber rings in position. The rubber members provide ample insulation and at the same time give the desired flexibility. It is furnished in sizes from



FLEXIBLE INSULATED COUPLING

5 horse-power up. Such a coupling is especially desirable where electric motors are direct-connected to machinery which is subject to vibration, such as tube mills, punches, shears, etc., where the coupling relieves the motor from the shocks and jars of the machine. The end thrust is also overcome allowing the motor bearings to run without heating.

Perpetual Motion Again

BY GLENN S. ECHOLS

Newton's third law has been overcome —again. I know this, for I read rerecently in a long advertisement printed in *The Hartford Courant*, issue of March 28, page 21, as follows:

FOR SALE—A Wonderful Machine. A machine that will overcome Newton's third law and transfer a horse-shoe magnet force into a revolution, and will produce more power than what is put into the machine. Because not having the funds to build a machine in a perfect way so I can demonstrate it in practical mechanical working order. It is a perfect success from the mechanical laws of nature which I have tested in their natural working order, and from the small machine which I have in perfect working order to demonstrate from that when the electro or the horseshoe magnet system is connected with the machine it will do the work. Just as I have stated, every professor on the face of the earth will have to give the same statement as I have in regard to this machine in the form it does its work, even in case it should not produce more power than what is put into the machine, it would be one of the most mysterious mechanical laws that the professor ever came across which they pronounce correct today, therefore it would be a valuable machine to put on exhibition to demonstrate to the world in a mechanical form that it is impossible to make a machine that will produce more power than what is put into the machine it would show then that it was imperative to get the perpetual motion system in a mechanical form. Therefore by putting this machine on exhibition if it should not work it would bring in a small fortune, more than the machine would cost to build, and by publishing a book of the six mechanical laws which I have worked out, what is the foundation of this machine to work from that would bring in a small fortune for itself; therefore it is impossible to lose one cent by investing in this machine. I have studied these laws out to their limits and according to the laws the machine can be made to drive small or big machinery. Now I would like to know if there is a lady or gentleman on the face of the earth who has funds enough that will be so generous and borrow me Five Thousand Dollars so I can build a machine and exhibit it before the public. E. C. REITER, 5 Stone street, Rockville, Conn.

I was a reporter once and I even wielded the blue pencil on the "State desk" of the paper publishing this remarkable acknowledgment, but the wording of this article is beyond me, and I fain would leave the copy in its original form, so that you may have the pleasure of winding your mind around its tortuous passages.

The inventor can "transfer a horse-shoe-magnet force into a revolution." Let me say right here that any man who can do this *ought* to have help—in some way or another. So I have selected you to be the instigator of a great work, viz., put this inventor's appeal before all *bona fide* philanthropists. Let them read for themselves that the machine "is a perfect success from the mechanical laws of nature which I have tested in their natural working order."

But let us by no means have a stingy

philanthropist for this project, as the inventor hints that the cost of building his machine will be prodigious. As soon as you get a philanthropist cornered, however, it will be best to show him, in "scare-head" type, that he is taking no chances whatever, for the inventor says that even if the machine should not work when put on exhibition, it would bring in a small fortune, more than it would cost to build it.

In a special to the same paper, nine days later, the statement is made:

"By belts and pulleys he says he can demonstrate that this machine once started with, say a one-horse-power motor, will develop at least three horse-power, so that the extra horse-power may be used to run other machinery. His theory is that a one-horse-power motor running one of his machines, and producing two additional horse-power of force, will leave one to run a dynamo of another horse-power (the dynamo furnishing the electric current to run the original motor), leaving still one horse-power to be utilized for other purposes. Reiter advertises that he has worked out the following laws in a mechanical form: "First, overcome gravity; second, turn external force directly into natural friction; third, a moving dead center; fourth, to make a lever force travel on the same time as the small force travels; fifth, turn stationary pressure to motion; sixth, to make the compound forces pull in the same direction."

With this staring them in the face, builders of engines and turbines can make preparations to go out of business.

A New Threading Tool

In spite of the increasing use of turret lathes, with their different forms of dies and chasers, many screw threads are still cut in the lathe with single-pointed tools. There is, of course, much work where this is the only practical way to manufacture. Thus far little, if any, advance has been made over early methods to quicken and cheapen such screw cutting, aside from the adoption of high-speed steels for the tools.

Several articles in the AMERICAN MACHINIST have described a tool setting for thread cutting, in which the compound rest is placed at an angle a little less than 30 degrees with the center line of the lathe. The tool is located as usual and fed by the screw of the compound rest. Fig. 1 shows the direction of feed by the arrow and the shaded portion at *A* indicated the section of chip.

A system of thread-cutting tools has been designed by Frank E. Ross, having new features in this line. It was developed at a time when there were a number of 1¼-inch shafts to thread. The thread was long; the stock was soft, stringy, cold-rolled steel and about 45 minutes were required on an average to cut each thread. With a tool made as will be described the actual time of cutting was reduced to three minutes and the average for the lot to five minutes.

Fig. 2 shows the point of a tool of this system opposite a diagram of a thread. The shaded portions *B* and *C* are sections of a chip. Thus while it cuts at two points it cuts the thread on only one side; each chip is independent of the other. The tool is fed straight into the work for an ordinary thread as in usual screw-cutting practice. See the direction of the arrow. From a comparison of Figs. 1 and 2 it will be seen that the character of the chip is similar, but that for a given movement of the tools twice as much metal will be removed with the Fig. 2 setting as with the Fig. 1 setting. The first chip taken over a thread can be as deep as the material will stand and not tear. For ordinary pitches and clean cutting materials three passes are all that are necessary. It is, therefore, a quick and economical system to use.

Figs. 3 and 4 are of interest as showing two styles which did not prove to be very successful; just why it is difficult to say. They are the forerunners of the style of Fig. 2.

The system is applicable to all kinds of thread-cutting tools; single pointed, circular, chasers, taps, dies, etc. Fig. 5 shows a single-pointed tool. Its element of novelty is, of course, the character of the cutting point. Fig. 6 shows a circular threading tool, which is especially advantageous; embodying this same principle. Fig. 7 illustrates this same tool disassembled. The holder is of almost as much interest as the tool itself.

The holder shank *D* is made of mild steel with an enlarged end containing a taper hole. The lower edge is straight, thus there is ample material below the hole to insure the maximum of rigidity from the section of stock used. Into its taper hole is fitted the hollow taper sleeve *F*. The smaller end of this sleeve is slabbed and when drawn into its place forms a key to fasten the circular cutter to the shank. Of course the sleeve can be knocked out, placed in a new position and drawn home again. Thus it is an adjustable key, capable of taking an indefinite number of positions in the holder and giving the freest opportunity to set the circular cutter.

The circular tool, *E* of Fig. 7, has a milled groove in the back to receive the end of the sleeve *F*. The opposite side is countersunk for the head of the screw *H*. This screw passes through the cutter and taper sleeve. It is tightened by the finished and case-hardened nut *G*, which bears on the larger end of the sleeve. There is considerable surface in contact between the cutter and the holder and the tension screw holds these surfaces together as well as tightening the sleeve in its seat. Thus the cutter is secured in two ways; by friction against the holder and mechanically by the taper sleeve key.

The face of the cutter is marked with the pitch and the kind of thread. It needs but to be mentioned to be self evident that there must be a cutter for each pitch and thread. This line of tools for all ordinary pitches and for United States standard and standard V threads is made in stock sizes by the Boston Tool Company, 207 Bridge street, Cambridge, Mass.

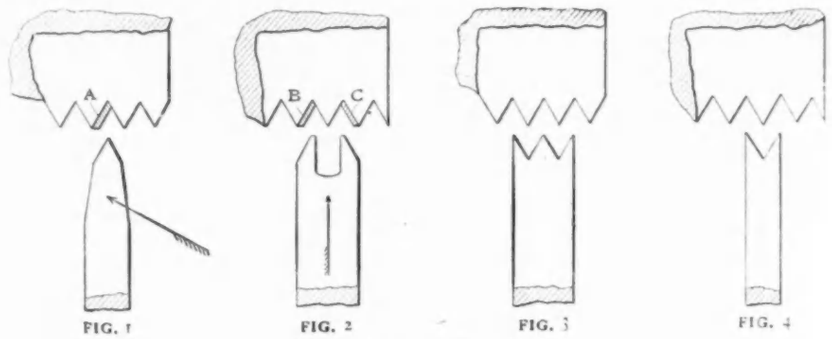
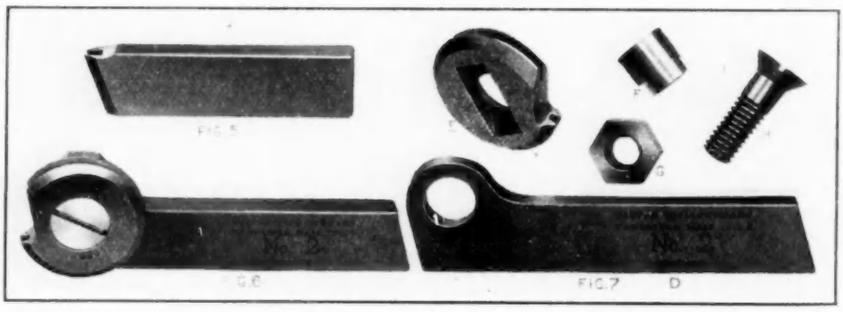


FIG. 1 FIG. 2 FIG. 3 FIG. 4

A NEW THREADING TOOL



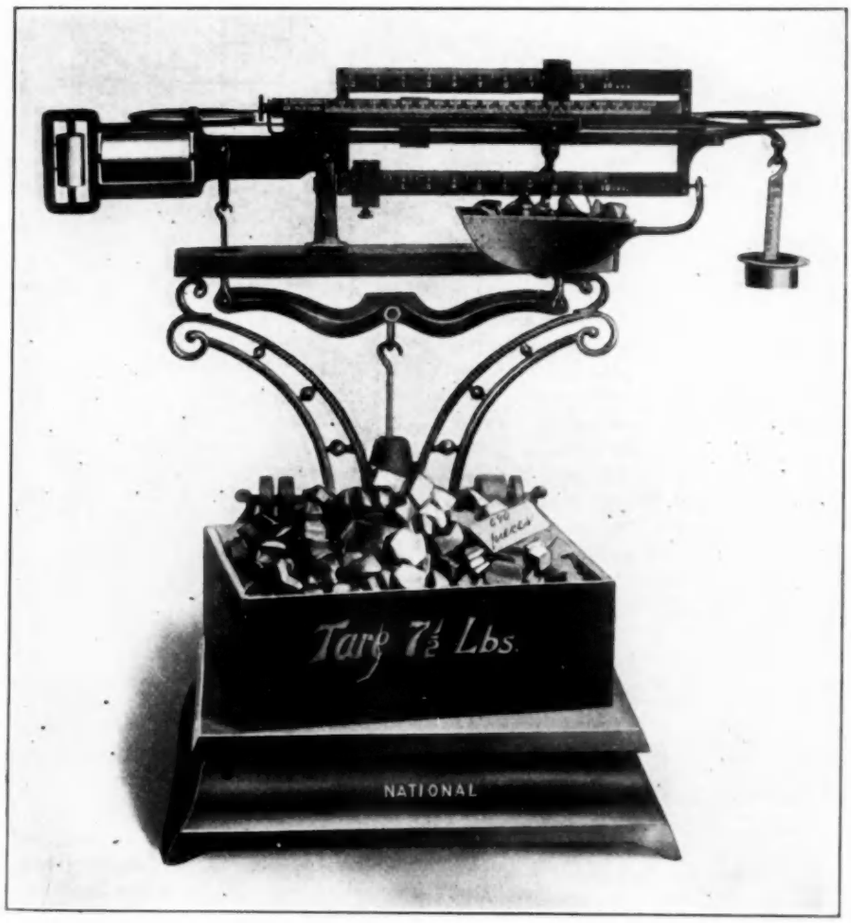
THE CONSTRUCTION OF THE TOOL

A Counting and Weighing Machine

Every manufacturer of small parts is aware of the difficulty as well as the expense of obtaining accurate count, either while the articles are being made, or when they are prepared for sale. It is equally important in determining the earnings of piece workers, the cost of work, or in packing for shipment to avoid claims of shortage which are not only annoying, but are exceedingly difficult to disprove.

This machine is in reality a very accurate scale, having in addition to regular weighing devices a feature which enables accurate counting through the medium of ratio weighing. With the ratio pan, loaded with small parts, at the extreme left or pointing to zero it is directly over the scale-beam bearings and does not in any way affect direct weighing, whether it is empty or full. The pointer connected with this is read along a four-sided beam which is graduated according to the weight of material to be weighed. In this case the side in view is divided with a ratio of 20 to 1, which means that by placing 20 of the pieces to be weighed in the ratio pan, setting the upper beam to 7½ pounds, which is the weight of the box or the tare, that any number of these pieces placed in this box will be accurately counted by the position of the pointer when the scale balances. In the position shown it indicates that there are 690 pieces in the box, as the number in the ratio pan has no effect whatever on the counting.

The other sides of this scale are divided in different ways as may be desired and the scales can be prepared to weigh any kind of material within their capacity. The smaller sizes are adapted for accurately counting pieces weighing from 1/200 of an ounce up to their capacity, and the machine shown will handle anything from ¼ ounce and over. The standard bar is graduated to count to a maximum of 10,000 units or 800 dozen or 200 gross, according to the way in which the material is to be weighed or counted.



SCALE FOR COUNTING

If it is desired to weigh out any special number of pieces, as 500 on the scale shown, it is simply necessary to put the number called for on the beam, 20 in this case, into the ratio pan, set the pointer at 500 and shovel or otherwise place the pieces in the box or other receptacle on the scale after the weight or tare has been provided for on the upper scale, as before mentioned. No counting will be necessary, as when the scale balances you are assured that the right number is in the box. It can also be used to count material which does not run exactly uniform in weight, but in this case it of course, only gives a fair average which is likely to be much closer than the usual hand counting.

The machines are being quite extensively introduced into various shops where they are credited with being savers of time, preventers of mistakes and, the unpleasant misunderstandings which go with them. They are made by the National Scale Company, Beaver Falls, Penn., in any size up to platform scales which have a weighing capacity of 6000 pounds.

Errata—The Factor of Safety in Ball Bearings

In Fig. 5, on page 720, the circle representing a ball which is intersected by the line of force marked *P* should not have been drawn tangent to the circle representing the shaft, but should have been drawn some distance from it. In Fig. 7 the outer race of the spherical rollers should have been shown conical, not spherical.

Machine-shop Work in Chile

By A. Prince

Since the earthquake of two years ago there has been plenty of work for everybody, as the owners of the places that were burnt down have been either trying to collect enough out of the débris to begin again, or, if they had a little capital, buying new machines and beginning again, or else have been looking for work as workmen. I lost a 10-inch Sebastian lathe among other things, but managed to buy a German speed lathe from an optical shop and am managing very well as all my work is small.

I have a lot of screws (British Association thread Nos. 0 to 10) to make, and thought that perhaps it might interest some of your readers to know how I make them. I found, among other things, a Rodger's adjustable hollow mill and turned a plug to fit in it. The other end of the plug I turned tapering to fit in the tailstock of the lathe. Then I centered a brass bar with just enough out of the chuck to make a screw, turned it to the diameter of the head with the cutting-off tool, to save changing tools, and then ran a mill up with the back center wheel to the thread diameter of the screw. Afterward, with Green River dies I ran on the thread; then cut off the stock and fed up again. The operation takes less time than telling it. For slotting the heads I put them in a die again, the die in a vise and filed them.

There is one thing that I can't understand here and that is how to compete

with home (American) manufacturers. We wanted some wire connectors, for No. 10 wire and couldn't wait for them. So I bought enough ½-inch bar brass to make the quantity wanted, but found I had to pay more than double for the bar brass than connectors would cost, without counting my time or even the brass for the screws. For everything else that you want to make here the raw material costs more than the finished article. There is plenty of copper here, but they send it out of the country to be melted and refined and then we have to buy it back again at most extravagant prices.

There is no iron here, or else they don't work it, so all bars, plates, etc., have to be brought out from home. So you see that the machine shops are mostly repair shops; sometimes repairs cost more than the original machine, but if the machine was thrown away it would mean waiting for about six months for another one from home. The cast iron made here is from old grate-bar and burnt iron. Talk about high-speed steel! I think this stuff would compete very well with it for hardness; passing a file over it makes the file shine like silver. The worst of this is that no hardware store keeps the things you require. I went all over town to find a 1/16-inch drill and at last had to make one out of the handle of a three-square file. Drill rod is like *x* in algebra—an unknown quantity. Even a small emery wheel can't be got for love nor money, at least one under 6 inches with a ¾-inch hole in it. When I look at the advertisements in the AMERICAN MACHINIST it makes my mouth water to think what I could get if I were only there.

Molding a Hydraulic Cylinder

BY D. S. FIDES

A rush order being obtained by the foundry to make a pattern and mold the hydraulic cylinder, as shown in Fig. 1, for a break-down job, it was decided to make it as described below. This method gave such good results in the quality of the casting as well as in the time consumed in making the pattern and molding the same that an order was obtained for several others of different sizes, and they were made in the same manner.

FIG. 1. HYDRAULIC CYLINDER TO BE MOLDED

The pattern consisted of a wooden ring turned inside and outside so it would leave its own core. This was made 20 inches in length and of the diameter of the cylinder as shown in Fig. 2. On top of this was fitted a cross with a 2-inch hole in the center to fit over the spindle as shown in Fig. 3. The flanges were made in four segments or loose pieces that could be imbedded in the mold and a gage stick was made equal to the exact length of the cylinder. This was marked to locate the upper flange by, and its total length was used to obtain the length of the cylinder.

While the pattern was being made the flasks were brought into the foundry and fitted up as shown in Fig. 4; the spindle seat *A* was bedded in the floor, upright pieces *B* were erected on this spindle seat to make a frame which would support the core and prevent it from sagging. These were cast bars 2½ inches square and 10 feet long in which were cast holes 1 inch in diameter and 6 inches between centers. In these holes were bolted cast-iron cross pieces *C* which were ¾ inch thick, 3 inches wide and of the proper length. In these were drilled 1-inch holes 2 inches between centers.

The mold was started by using a short spindle, 3 feet long, with a sweep attached to sweep the bed. A cope flask with the bars set 2 inches below the joint of the flask was used for the bottom box, and this was located so the spindle would come in the center of the flask.

In preparing the bed for said box, we put a pulley ring on the step and rammed sand around it, when the bed was swept the sweep board was removed and the pulley ring drawn, leaving about 20 inches of the spindle seat bare. Then the flask was placed on the bed and set true. Our short spindle was now replaced by one 12 feet long. The long bars *B* were then placed upright on the spindle seat at a fixed distance from the spindle and held there until four plates *C* were bolted to them top and bottom. Additional security was given by wedging them tight against the bars of the bottom flask.

FIG. 2. Pattern

FIG. 3. Cross

Sand was then filled in the flask and rammed up the required distance to strike it off level with joint *D*. The top pieces *C* were then taken off the bars *B* and the pattern, Fig. 2, with the cross attached for a guide was put on the spindle and let down to joint *D*. The cross pieces *C* were then replaced at the top of the bars and the pattern leveled. The flange which was made in four segments was placed against the pattern and sand rammed around it.

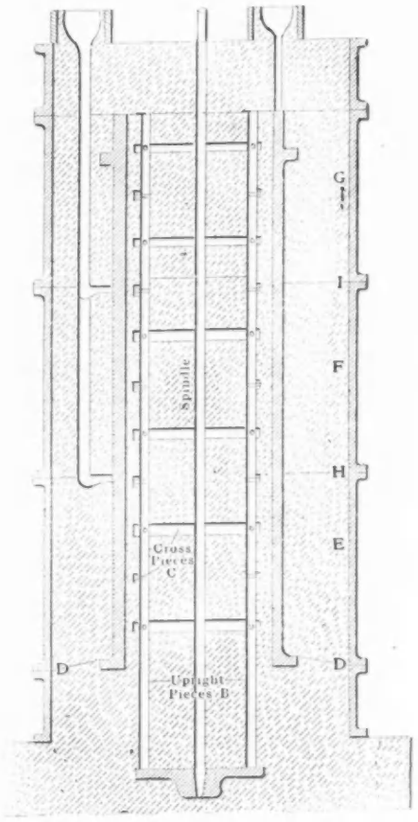


FIG. 4. SECTIONAL VIEW OF MOLD WHEN COMPLETED

The gage stick was placed with one end on the same bed level as the pattern, and as near as possible to the spindle; it was fastened there with a collar and set-screws. This collar was so fixed that the bottom of it was on a line with the top of the top flange, therefore, in drawing up the pattern, when the cross piece, Fig. 3, on the pattern came against the collar the exact location of the top flange was obtained.

The round, cheek flasks *E*, *F* and *G* had holes bored in their face, so that loose bars could be bolted to the flasks according to the requirements of the job. These bars having been previously bolted in the cheeks, they were ready to lower into place.

The work of ramming up the mold was then commenced. The outside was gaggered and rammed up in the usual way. More care was taken with the inside; at intervals the whole way up the plates *C* were bolted to the bars *B* and the sand was well rodded in addition.

The inside or core was well vented as the ramming proceeded, each series of ventings being well covered with fine coke, and connected with each other until the top of the mold was reached.

The outside which was rammed concurrently with the inside, was done by ramming to the top of the pattern which was 20 inches deep; then drawing the pattern up and ramming again until the joint *H* was reached. Cheek *F* was then lowered on and the runner sticks placed, the idea being to cut gates into the mold at joints *H* and *I*.

The mold was then brought up to the parting level *I* by a series of sand ramming, and pattern drawing as before, parting sand was put on and the cheek *G* lowered into place. Two more runner sticks were placed here to connect with the runners in cheek *F* and to supply gates cut at this particular parting.

The mold was then rammed as before and pattern drawn until the cross on the pattern came against the collar on the spindle. The bottom of the flange was now formed, nailed and vented. The collar on the spindle was then removed and the pattern drawn up again.

The outside of the flange was formed with four segments as at the bottom, but in this case the pieces were drawn and cake cores placed in the mold, against the pattern, to form the top of the flange, after which the pattern was drawn up enough to form the top of the cylinder, and the sand rammed around it. This extra 6 inches which it was drawn above the flange formed a dirt reservoir.

The pattern was then drawn clear of the mold, and the three cheeks lifted off, finished, blacked and put in the oven to dry, and the pieces which formed the bottom flange were removed.

The core was blackwashed. Fires were placed in position around it and the whole covered in and left to dry for a couple of days. When the cheeks were dry it was uncovered, the fires taken away, the core calipered to see that it was the proper size. The cheeks were then replaced in their proper order, cake cores were used to cover the top mold, the cope was then put on and the whole bolted securely together.

Runner sticks were placed where wanted, vents looked after, the cope was rammed up and runner made, and it was cast at once. After the heat was over the long spindle was withdrawn, and the cylinder taken to the machine shop to finish what proved to be a very good casting.

Business Items

The American Blower Company, of Detroit, Mich., has purchased the foundry formerly operated by the Northwestern Foundry and Supply Company, manufacturers of cast iron soil pipe, fittings and plumbers' specialties. They expect to operate this foundry for the manufacture of blower, exhaust fan, engine and heater castings.

Want Advertisements

Rate 25 cents a line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper list free. E. G. Smith Co., Columbia, Pa.

Translator of catalogs into Russian. Box 159, AMERICAN MACHINIST.

If you use small gears in large quantities, write Berry & Parker, Erie, Pa.

Steel case hardened; modern methods. Boston Gear Works, Norfolk Downs, Mass.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Special machinery accurately built. Screw machine and turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Automatic machinery designed; special purpose machines; working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia.

We are anxious to procure copies of August 25, 1904, issues of AMERICAN MACHINIST. Address, with price, Box 144, AMER. MACHINIST.

We are equipped to turn out twice the number of gears used on our own work, can we do yours to fill in? Samuel M. Langston, Camden, N. J.

Shop in Massachusetts well fitted for electrical work desires machinery to build to order or by contract. Box 112, AMERICAN MACHINIST.

Valuable United States patent for sale outright or on royalty. The latest continuous blueprint machine. B. J. Hall, 41 Castelnau, Barnes, London, England.

Machine screws in small or large quantities direct from factory at low prices. Send particulars of sizes and threads required. Box 97, AMERICAN MACHINIST.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Machinists take notice. Purchase castings and blueprints of high-grade gasolene motor, of world-wide reputation and at a profitable business. Write today. F. P. Conrad, 242 Freeport St., Harrison Sq., Boston.

British patent rules, 1908. We can produce light, fine engineering and mechanical specialties and tools, accuracy and finish guaranteed. Model Manufacturing Co., 52 Addison Road, North, Holland Park, London.

Wanted—Some good specialty or new type of machine tool to manufacture in a modern plant, equipped with high grade tools and with ample capital. Box 151, AMER. MACHINIST.

Make money by patenting and selling your invention. Must be useful. Delay dangerous. E. P. Thompson, M. E., Registered Patent Attorney, Member A.S.M.E. and A.I.E.E., Door 40, 39 Cortlandt St., New York.

Machinery built to order and by contract; special parts made; gear cutting, automobile and pattern work, punch press and screw machine work, tools, dies, etc. Blair Tool and Machine Works, West and Morris Sts., New York City.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CALIFORNIA

Foundry foreman; fifteen years' experience in big shops. Hustler, with understanding to bring best work out of employees. Wishes position as foundry foreman again in California. Box 156, AMERICAN MACHINIST.

CONNECTICUT

Draftsman, nine years' shop and two years' office experience; any location. Box 109, Clinton, Conn.

MASSACHUSETTS

Experienced designer on automatic and special machinery. First-class references. Box 154 AMERICAN MACHINIST.

Wanted—Position as designing draftsman by a Swedish technical graduate; 27 years of age, with three years' experience in United States. Box 119, AMERICAN MACHINIST.

NEW JERSEY

Wanted—A position by an expert mechanic who can reorganize a plant on a paying basis. Box 146, AMERICAN MACHINIST.

NEW YORK

Mechanical draftsman desires position. Nine years' shop experience. Engineering office preferred; technical graduate. Box 142, AM. MACH.

Superintendent, good mechanic and executive, with necessary experience to make your plant pay, desires change. Box 137, AMER. MACH.

Draftsman, fifteen years' experience designing and constructing power houses and industrial plants. Capable superintendent. Box 130, AMERICAN MACHINIST.

Mechanical engineer, college graduate, wants position as assistant superintendent, chief or designing draftsman; experience in steam engineering, air compressors and pneumatic mining machinery; references A-1. Box 158, AMERICAN MACHINIST.

A man with general experience in the management of modern gas and oil engine work and also with the detail of construction on all types of internal combustion engines, open for a position as superintendent or manager about June 1. Box 143, AMERICAN MACHINIST.

Ambitious young man, 20, now employed at sheet metal trade, wishes steady position as inside machinist's helper, with chance of advancement. Only a good and reliable company wanted. Greater New York or vicinity preferred. Can furnish references. Box 155, AMERICAN MACHINIST.

OHIO

Up-to-date young mechanic, first-class designer and salesman, wants permanent technical position. Has light machine tool wants manufactured. Box 141, AMERICAN MACHINIST.

PENNSYLVANIA

Automatic screw machine foreman wishes position. Energetic, up-to-date young man. Expert on Brown & Sharpe and Acme machines. Increased production guaranteed. "Temper." AMERICAN MACHINIST.

VIRGINIA.

Young man, now general manager $50,000 general machine shop, desires similar position or one as assistant superintendent. Good credit man, practical machinist, technical graduate and can furnish A-1 references. South preferred. Box 113, AMERICAN MACHINIST.

WISCONSIN

Position as factory manager or general superintendent by thoroughly practical shop man. Interchangeable manufacture. Competent to take entire charge of factory and produce results. Replies desired only from those who want an A-1 man and who are willing to pay liberally therefor. Address, Box 150, AMERICAN MACH.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CALIFORNIA

Wanted—Two competent toolsmiths, Navy Yard, Mare Island, Cal. Pay $4.24 per diem. Must be able to dress and temper all classes of tools. Must be citizens. Transportation will not be paid by Government. Apply for information to "Board of Labor Employment, Navy Yard, Mare Island, Cal."

ILLINOIS

Wanted—A thoroughly capable working foreman. Must be experienced mechanic on brass work, systematic, good executive ability. We manufacture storm fronts, brass finished, for automobiles. In Chicago; steady position, excellent opportunity for advancement for the proper man. Address with references, stating wages expected. Box 127, AMERICAN MACH.

MASSACHUSETTS

Wanted—Foreman, sub-foreman, assembling and machine hands, experienced in monkey-wrench manufacturing or similar work. Box 128, AMERICAN MACHINIST.

MICHIGAN

Drop Forge Superintendent Wanted—One

accustomed to steam and board drops, estimating costs, with a thorough knowledge of the business; no experimenters wanted. Fine opening to the right man. Address, "Forger," care AMERICAN MACHINIST.

NEW YORK

Estimator Wanted—One experienced in estimating quantities and costs of machinery, including purchase cost, manufacturing cost and erection cost. A man with a technical education and office experience preferred. Address Box 145, AMERICAN MACHINIST.

Wanted—Brass machine shop foreman, experienced on valves preferred. In replying state if now employed, age, experience, wages expected and references. Box 139, AMERICAN MACHINIST.

A Machine shop foreman wanted; one who is accustomed to large work and big shop, about fifty miles from New York city. Must be thoroughly up-to-date; high speed and energetic hustler. Able to turn out large quantities of miscellaneous work at lowest cost. No others need apply. State age, salary wanted and experience to Box No. 200, 264 Eighth avenue, New York City.

OHIO

Wanted—A-1 practical man to sell machine tools in Central States. Box 134, AM. MACH.

Wanted—Good practical man on presses and forging machinery capable of selling. Territory Central States. Box 135, AMERICAN MACH.

Tool Designer Wanted—One who is a practical toolmaker as well as designer. Must be a fast man at the drawing board for designing jigs, fixtures and automatic machinery. State age, salary expected and where previously employed in first letter. Box 148, AMERICAN MACHINIST.

PENNSYLVANIA

Wanted—First-class machine shop foreman, location northwestern part Pennsylvania, best of references required. To the right party permanent position. State salary expected. Box 157, AMERICAN MACHINIST.

For Sale

Canadian patent on ball bearing, with safety factor, described in American Machinist, May 7, 1908. Box 147, AMERICAN MACHINIST.

For Sale—One second-hand Uehling Steinbart & Company pneumatic pyrometer complete, with recording gage. Box 140, AMER. MACH.

Machinery manufacturing business for sale, gas engines, in Wisconsin, doing $80,000 annually, earnings $15,000, good reasons. Box 152, AMERICAN MACHINIST.

For Sale—Twenty-two inch by eight foot Bardons & Oliver turret lathe. Used six months and as good as new. Box L. Demopolis, Alabama.

Fire alarm patent for sale. Alarm can be manufactured very cheaply. Something new, everybody will buy one. Address, David G. Thalman, Kansas City, Mo.

Orders received by mail for my metal article. At a reasonable price a half interest in my patents and business is offered to him who can take up the manufacture of it. Sold by stores and demand large. Retails at over $2. Box 149, AMERICAN MACHINIST.

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Abrasive Materials

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American Emery Wheel Co., Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Dickinson, Thos. L., New York.
Norton Co., Worcester, Mass.
Pittsburg Emery Wheel Co., Pittsburg, Pa.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.

Agents, Foreign Machinery

C. I. F. Co., New York.

Air Lifts

Ingersoll-Rand Co., New York.

Alundum

See Grinding Wheels.

Arbor Presses

Barnes Co., W. F. & John, Rockford, Ill.
Marshall & Huschart Machinery Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Wilmarth & Morman Co., Grand Rapids, Mich.

Arbors

Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt Chuck Co., Frankfort, N. Y.
Skinner Chuck Co., New Britain, Conn.
Union Twist Drill Co., Athol, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Balancing Ways

Bowsher Co., N. P., South Bend, Ind.

Barrels, Steel

Lyon Metallic Mfg. Co., Aurora, Ill.

Barrels, Tumbling

Globe Machine & Stamping Co., Cleveland, O.

Bars, Boring

Beaman & Smith Co., Prov., R. I.
Cleveland Twist Drill Co., Cleveland, O.
Elmes Engineering Works, Chas. F., Chicago, Ill.
Krieger Tool & Mfg. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Bearings, Ball and Roller

Boston Gear Works, Norfolk Downs, Mass.
Hyatt Roller Bearing Co., Harrison, N. J.

Belt Dressing

Cling-Surface Mfg. Co., Buffalo, N. Y.
Desmond-Stephan Mfg. Co., Urbana, Ohio.
Dixon Crucible Co., Joseph, Jersey City, N. J.
Schieren Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

Belt Fasteners

Bristol Co., Waterbury, Conn

Belt Filler

Schieren Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

Belt Lacing Machine

Birdsboro Steel Foundry & Mach. Co., Birdsboro, Pa.

Belt Shifters

The L. & D. Co., Boston, Mass.

Belting, Leather

Chicago Raw Hide Mfg. Co., Chicago, Ill.
Schieren Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

Benches, Work

Manufacturing Equipment & Engineering Co., Boston, Mass.

Bending Machinery, Hydraulic

Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Bending Machinery, Plate

Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.

Bending Machinery, Power

Bethlehem Foundry & Machine Co., South Bethlehem, Pa.
Boynton & Plummer, Worcester, Mass.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Bending Tools, Hand

Estep & Dolan, Sandwich, Ill.
Wallace Supply Co., Chicago, Ill.

Blocks, Chains

See Hoists, Hand.

Blocks, Die

Nicholson & Co., W. H., Wilkes-Barre, Pa.

Blowers

American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
General Electric Co., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Roth Brothers & Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.

Blue Print Machines

General Electric Co., New York.

Bolt and Nut Machinery

Acme Mchry. Co., Cleveland, O.
Boynton & Plummer, Worcester, Mass.
Davis Machine Co., W. P., Rochester, N. Y.
Foote-Burt Co., Cleveland, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Landis Machine Co., Waynesboro, Pa.
Manville Mach. Co., E. J., Waterbury, Conn.
McCabe, J. J., New York.
Milton Mfg. Co., Milton, Pa.
Mummert, Wolf & Dixon Co., Hanover, Pa.

Bolt and Nut Machinery —*Continued.*

National-Acme Mfg. Co., Cleveland, O.
National Machinery Co., Tiffin, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Engineering Works, Ellwood City, Pa.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Bolt Heads

Lang & Co., G. R., Meadville, Pa.

Bolts and Nuts

Milton Mfg. Co., Milton, Pa.
National-Acme Mfg. Co., Cleveland, O.

Bone for Case Hardening

Rogers & Hubbard Co., Mindletown, Conn.

Books, Technical

American School of Correspondence, Chicago, Ill.
Hill Publishing Co., New York.
Longmans, Green & Co., New York.
Sames, Chas. M., Jersey City, N. J.

Boosters

Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal

Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Betts Mach. Co., Wilmington, Del.
Boynton & Plummer, Worcester, Mass.
Detrick & Harvey Mach. Co., Wilmington, Del.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Inc., Boston, Mass.
Lucas Mach. Tool Co., Cleveland, O.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Rockford Drilling Mach. Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Boring and Turning Mills, Vertical

American Tool Works Co., Cin., O.
Baker Bros., Toledo, O.
Baush Mach. Tool Co., Springfield, Mass.

Boring and Turning Mills, Vertical —*Continued.*

Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mach. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Mitts & Merrill, Saginaw, Mich.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Boring Tools

Armstrong Bros. Tool Co., Chicago, Ill.
Krieger Tool & Mfg. Co., Chicago, Ill.

Boxes, Tote

Lyon Metallic Mfg. Co., Aurora, Ill.

Box Tools, Roughing

Bardons & Oliver, Cleveland, O.

Brazing

Industrial Oxygen Co., New York.

Broaching Machines

Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Inc., Boston, Mass.
Lapointe Mach. Tool Co., Hudson, Mass.

Bulldozers

Bliss Co., E. W., Brooklyn, N. Y.
National Machinery Co., Tiffin, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Cabinets, Tool

Armstrong Bros. Tool Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Lyon Metallic Mfg. Co., Aurora, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Calipers

Brown & Sharpe Mfg. Co., Providence, R. I.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Cams

Bilgram, Hugo, Phila., Pa.
Boston Gear Works, Norfolk Downs, Mass.

Carborundum

See Grinding Wheels.

Carborundum Paper and Cloth

Carborundum Co., Niagara Falls, N. Y.

Case-Hardening

American Gas Furnace Co., New York.
Rogers & Hubbard Co., Middletown, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Castings, Brass and Bronze

Clum & Atkinson, Rochester, N. Y.
Lumen Bearing Co., Buffalo, N. Y.

Castings, Die Molded

Berry & Parker, Erie, Pa.
Franklin Mfg. Co., H. H., Syracuse, N. Y.

Castings, Iron

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Cell Drier Machine Co., Taunton, Mass.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Taylor & Fenn Co., Hartford, Ct.

Castings, Steel

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Mass.
Cammel, Laird & Co., New York.

Cast Iron Brazing

Industrial Oxygen Co., New York.

Cement, Cast Steel

Clark Cast Steel Cement Co., Shelton, Conn.
Obermayer & Co., S., Cincinnati, O.

Centering Machines

Hendey Mach. Co., Torrington, Conn.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Mach. Co., D. E., New London, Conn.

Centers, Planer

Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

Chains, Driving

Boston Gear Works, Norfolk Downs, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Link-Belt Co., Philadelphia, Pa.
Morse Chain Co., Ithaca, N. Y.
Whitney Mfg. Co., Hartford, Conn.

Chisels, Cold

Whitman & Barnes Mfg. Co., Chicago, Ill.

Chucking Machines

American Tool Wks Co., Cin., O.
Bardons & Oliver, Cleveland, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Machine Co., Cleveland, O.
Gisholt Mach. Co., Madison, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Reed Co., F. E., Worcester, Mass.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.

Chucks, Drill

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H. New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Conn.
Grönkvist Drill Chuck Co., Jersey City, N. J.
Horton & Son Co., E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Lancaster Knife and Machine Wks. Lancaster, N. Y.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt Chuck Co., Frankfort, N. Y
Skinner Chuck Co., New Britain, Conn.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitman & Barnes Mfg. Co., Chicago, Ill.
Whitney Mfg. Co., Hartford, Conn
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe

Cincinnati Chuck Co., Cincinnati, O.
Cushman Chuck Co., Hartford, Conn.
Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.

Chucks, Lathe—*Continued.*

Skinner Chuck Co., New Britain, Conn.
Union Mtg. Co., New Britain, Conn.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer

Harrington & Son Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split

Hardinge Bros., Chicago, Ill.
Rivett Lathe Mfg. Co., Boston, Mass.
Sloan & Chace Mfg. Co., Ltd., Newark, N. J.

Circuit Breakers

Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Clamps

Hammacher, Schlemmer & Co., New York.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Starrett Co., L. S., Athol, Mass.
Tudor Mfg. Co., Taunton, Mass.
Williams & Co., J. H., Brooklyn, N. Y.

Clocks, Watchman's

Hardinge Bros., Chicago, Ill.

Clutches, Friction

American Tool & Machine Co., Boston, Mass.
Bliss Co., E. W., Brooklyn, N. Y.
Caldwell, Son & Co., W. H., Chicago, Ill.
Eastern Machinery Co., New Haven, Conn.
Evans Friction Cone Co., Newton Centre, Mass.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Williams Foundry & Machine Co., Akron, Ohio.

Coal Handling Machinery

Link-Belt Co., Philadelphia, Pa.

Compound, Core

Obermayer Co., S., Cincinnati, O.

Compound, Pipe Joint

Dixon Crucible Co., Joseph, Jersey City, N. J.

Compressors, Air

Blaisdell Machinery Co., Bradford, Pa.
Blanchard Machine Co., Cambridge, Mass.
Bury Compressor Co., Erie, Pa.
Clayton Air Compressor Works, New York.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.
Spacke Machine Co., F. W., Indianapolis, Ind.

Compressors, Gas

Blaisdell Machinery Co., Bradford, Pa.
Ingersoll-Rand Co., New York.

Cones, Friction

Evans Friction Cone Co., Newton Centre, Mass.

Connecting Rods and Straps

Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work

Blanchard Mach. Co., Cambridge, Mass.
Cell Drier Mach. Co., Taunton, Mass.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Ingle Machine Co., Rocester, N. Y.
Manville Bros. Co., Waterbury, Conn.
Merritt, Jos., Hartford, Conn.
Turner Mach. Co., Danbury, Conn.

Controllers and Starters, Electric Motor

Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Conveyors, Automatic

Lamson Consolidated Store Service Co., Boston, Mass.
Link-Belt Co., Philadelphia, Pa.

Coping Machines

Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York

Corundum

See Grinding Wheels.

Cotters

Cleveland Twist Drill Co., Cleveland, Ohio.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores

Cleveland Twist Drill Co., Cleveland, Ohio.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Counters, Revolution

Root Co., C. J., Bristol, Conn.
Schuchardt & Schutte, New York.
Veeder Mfg. Co., Hartford, Conn.

Countershafts

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders Iron Foundry, Providence, R. I.
Coates Clipper Mfg. Co., Worcester, Mass.
Evans Friction Cone Co., Newton Centre, Mass.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Mossberg Wrench Co., Central Falls, R. I.
Norton Grinding Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, Ohio
Smith Countershaft Co., Boston, Mass.

Countershafts, Friction

Evans Friction Cone Co., Newton Centre, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing

Evans Friction Cone Co., Newton Centre, Mass.
Gisholt Mach. Co., Madison, Wis.

Counting and Printing Wheels

Franklin Mfg. Co., H. H., Syracuse, N. Y.

Couplers, Hose

Independent Pneu. Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.

Couplings

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Davis Machine Co., W. P., Rochester, N. Y.
Link-Belt Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Williams Fdry. & Mach. Co., Akron, Ohio.

Cranes

Brown Hoisting Mach. Co., Cleveland, O.
Case Mfg. Co., Columbus, O.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Franklin Port. Crane and Hoist Co., Franklin, Pa.
Manning, Maxwell & Moore, Inc., New York.
Maris Bros., Philadelphia, Pa

Cranes—*Continued.*

Moore Co., Franklin, Winsted, Ct.
Nicholls, Wm. S., New York.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.
Vandyck Churchill Co., New York.
Yale & Towne Mfg. Co., New York.

Crank Pin Turning Machines

Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts

Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles

Dixon Crucible Co., Joseph, Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Crushers

Farrel Fdry. & Mach. Co., Ansonia, Conn.
Niles-Bement-Pond Co., New York.
Link-Belt Co., Philadelphia, Pa.

Cupolas and Ladles, Foundry

Obermayer Co., S., Cincinnati, O
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cups, Grease

Lunkenheimer Co., Cincinnati, O.

Cutters, Milling

Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hardinge Bros., Chicago, Ill.
Harrison & Knight Mfg. Co., Newark, N. J.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M.; Gloucester City, N. J.
Sloan & Chace Mfg. Co., Ltd., Newark, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Ward & Son, Edgar T., Boston, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines

Armstrong Bros. Tool Co., Chicago Ill.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Machine Co., W. P., Rochester, N. Y.
Hurlburt-Rogers Mach. Co., South Sudbury, Mass.
McCabe, J. J., New York.
Newton Mach. Tool Wks., Inc., Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Schmitz, August, Dusseldorf, Germany.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.

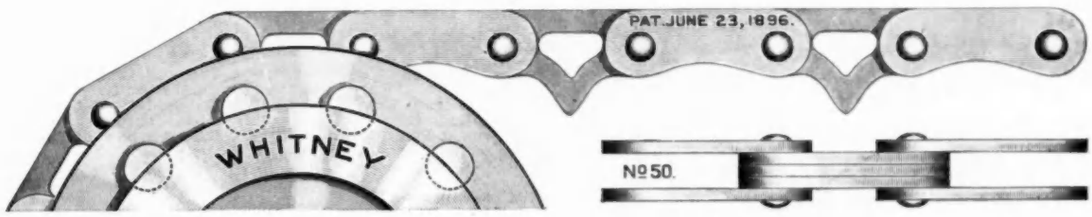
Cutting-off Tools

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Cleveland Twist Drill Co., Cleveland O.
Fitchburg Machine Works, Fitchburg, Mass.
Krieger Tool & Mfg. Co., Chicago, Ill.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Diamond Tools

American Emery Wheel Co., Providence, R. I.
Dickinson, Thos. L., New York.
Safety Emery Wheel Co., Springfield O.

"Whitney" Chains



A

B

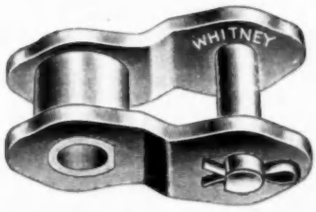
C

Connecting Link

Assembled Center Block

Side Link with Rivets Assembled

Side Link Plain



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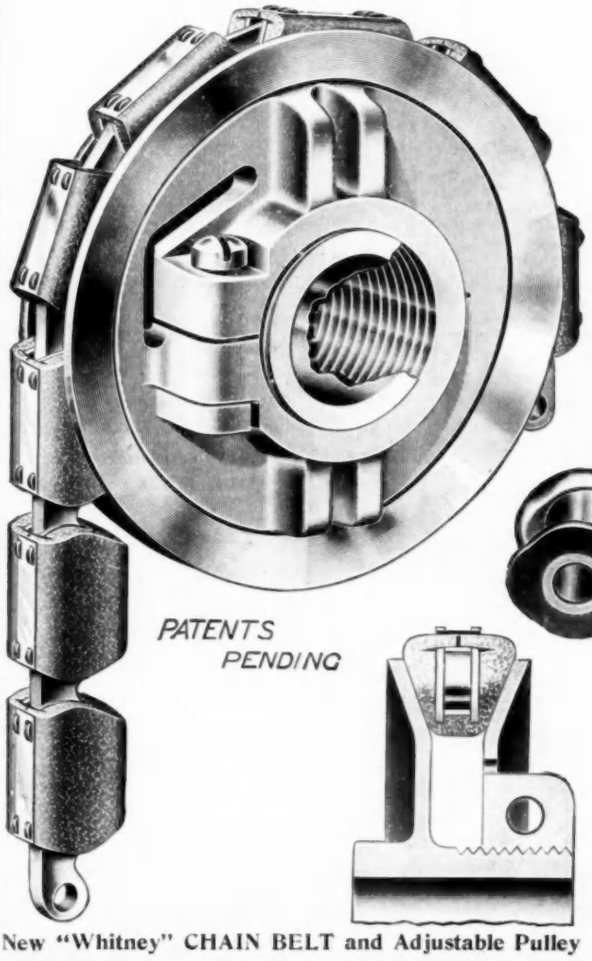

PATENTS PENDING

New "Whitney" CHAIN BELT and Adjustable Pulley

The Whitney Mfg. Co.

Hartford, Conn.

Dies, Sheet Metal

American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Consolidated Press and Tool Co., Hastings, Mich.
Ferracute Mach. Co., Bridgeton, N. J.
Globe Machine & Stamping Co., Cleveland, O.
Manville Bros. Co., Waterbury, Conn.
Risdon Tool Works, Waterbury, Conn.

Dies, Sub-Press

Sloan & Chace Mfg. Co., Newark, N.J.
Waltham Machine Works, Waltham, Mass.
Risdon Tool Works, Waterbury, Conn.

Dies, Threading, Opening

Allen Co., Chas. G., Barre, Mass.
Errington, F. A., New York.
Foote-Burt Co., Cleveland, O.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Machine Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Drawing Boards and Tables

Alteneder & Son, Theo., Philadelphia, Pa.

Kolesch & Co., New York

Drawing Materials

Alteneder & Son, Theo., Philadelphia, Pa.
Kolesch & Co., New York.
Technical Supply Co., Scranton. Pa.

Drafting Machines

Universal Drafting Mach. Co., Cleveland, O.

Drilling Machines, Bench

American Watch Tool Co., Waltham, Mass.
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Ingersoll-Rand Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.
Rockford Drilling Mach. Co., Rockford, Ill.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Ltd., Newark, N. J.
U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Boiler

American Tool Works Co., Cin., O.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Foote-Burt Co., The, Cleveland, O.
Ingersoll-Rand Co., New York.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass,

Drilling Machines, Multiple Spindle

Allen Co., Chas. G., Barre, Mass.
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Flather Planer Co., Mark, Nashua, N. H.
Foote-Burt Co., The, Cleveland, Ohio.
Fosdick Mach. Tool Co., Cin., O.
Hardinge Bros., Chicago, Ill.
Harrington Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Inc., Philadelphia, Pa
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Rockford Drilling Mach. Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Slate Machine Co., Dwight, Hartford, Conn.
Taylor & Fenn Co., Hartford, Conn.

Drilling Machines, Portable

Cincinnati Elec. Tool Co., Cin., O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.
Hisey-Wolf Mach. Co., Cin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Radial

American Tool Works Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dreses Mach. Tool Co., Cin., O.
Fitchburg Machine Works, Fitchburg, Mass.
Foote-Burt Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Foundry Co., Jno. B., Cincinnati, O.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Wormer Mchy. Co., C. C., Detroit, Mich.

Drilling Machines, Turret

Fay Machine Tool Co., Phila., Pa.
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright

Allen Co., Chas. G., Barre, Mass.
American Tool Works Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.
Davis Machine Co., W. P., Rochester, N. Y.
Fosdick Mach. Co., Tool Co., Cin., O.
Foote-Burt Co., Cleveland, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Kern Mach. Tool Co., Cincinnati, O.
Knight Machry. Co., W. B., St. Louis, Mo.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Mechanics Machine Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Rockford Drilling Mach. Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Taylor & Fenn Co., Hartford, Conn.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Wormer Mchry. Co., C. C., Detroit, Mich.

Drills, Center

Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O.

Drills, Electric

Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.
Independent Pneumatic Tool Co., Chicago, Ill.
Van Dorn Elec. Mfg. Co., Cleveland, Ohio.

Drills, Flat

Whitman & Barnes Mfg. Co., Chicago, Ill.

Drills, Hand

Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drills, Pneumatic

Clayton Air Compressor Works, New York.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.

Drills, Rail

Foote-Burt Co., Cleveland, O.
General Pneumatic Tool Co., Montour Falls, N. Y.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet

Armstrong Bros. Tool Co., Chicago, Ill.
Cleveland Twist Drill Co., Cleveland, O.
Hisey-Wolf Mach. Co., Cin., O.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Drills, Rock

Ingersoll-Rand Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.

Drill Speeder

Graham Mfg. Co., Providence, R. I.

Drying Apparatus

Sturtevant Co., B. F., Hyde Park, Mass.

Dynamos

Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Co., Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Electric Co., Cincin., O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrical Supplies

Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cincinnati, O.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Triumph Electric Co., Cincinnati, O.
Van Dorn Elec. & Mfg. Co., Cleveland, Ohio.
Wagner Elec. Mfg. Co., St. Louis, Mo.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery

American Tool Works Co., Cin., O.
Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Crescent Forgings Co., Oakmont, Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Roth Bros. & Co., Chicago, Ill.
U. S. Electrical Tool Co., Cincinnati, O.

Electrically Driven Tools and Machinery—*Continued.*

Van Dorn Elec. & Mfg. Co., Cleveland, Ohio.
Western Electric Co., Chicago, Ill.

Elevators

Albro-Clem Elevator Co., Philadelphia, Pa.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Co., Philadelphia, Pa.

Emery Wheels

See Grinding Wheels,

Emery Wheel Dressers

American Emery Wheel Co., Providence, R. I.
Desmond-Stephan Mfg. Co., Urbana, O.
Diamond Saw & Stamping Works, Buffalo, N. Y.
Dickinson, Thos. L., New York.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vitrified Wheel Co., Westfield, Mass.
Wrigley Co., Thos., Chicago, Ill.

Enclosures, Tool-room

Hart & Cooley Co., New Britain, Conn.

Engineering Appliances

Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Engineers, Mechanical and Electrical

Crocker-Wheeler Co., Ampere, N. J.
Merritt, Jos., Hartford, Conn.

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Automatic Mach. Co., Bridgeport, Conn.
Blaisdell Machinery Co., Bradford, Pa.
Grant Mfg. & Mach. Co., Bridgeport, Conn.

Engines, Motor

Franklin Mfg. Co., H. H., Syracuse, N. Y.
Ridgway Dynamo & Engine Co., Ridgway, Pa.

Engines, Steam

Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery

Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads

Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition, Machinery

Philadelphia Bourse, Phila., Pa.

Expanders, Tube

Nicholson & Co., W. H., Wilkes Barre, Pa.

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C. I. F. Co., New York.

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Manville Bros. Co., Waterbury, Conn.

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Fans, Electric

Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sturtevant Co., B. F., Hyde Park, Mass.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust

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Reichhelm & Co., E. P., New York.
Simonds File Co., Fitchburg, Mass.

Brown & Sharpe Mfg. Co.,
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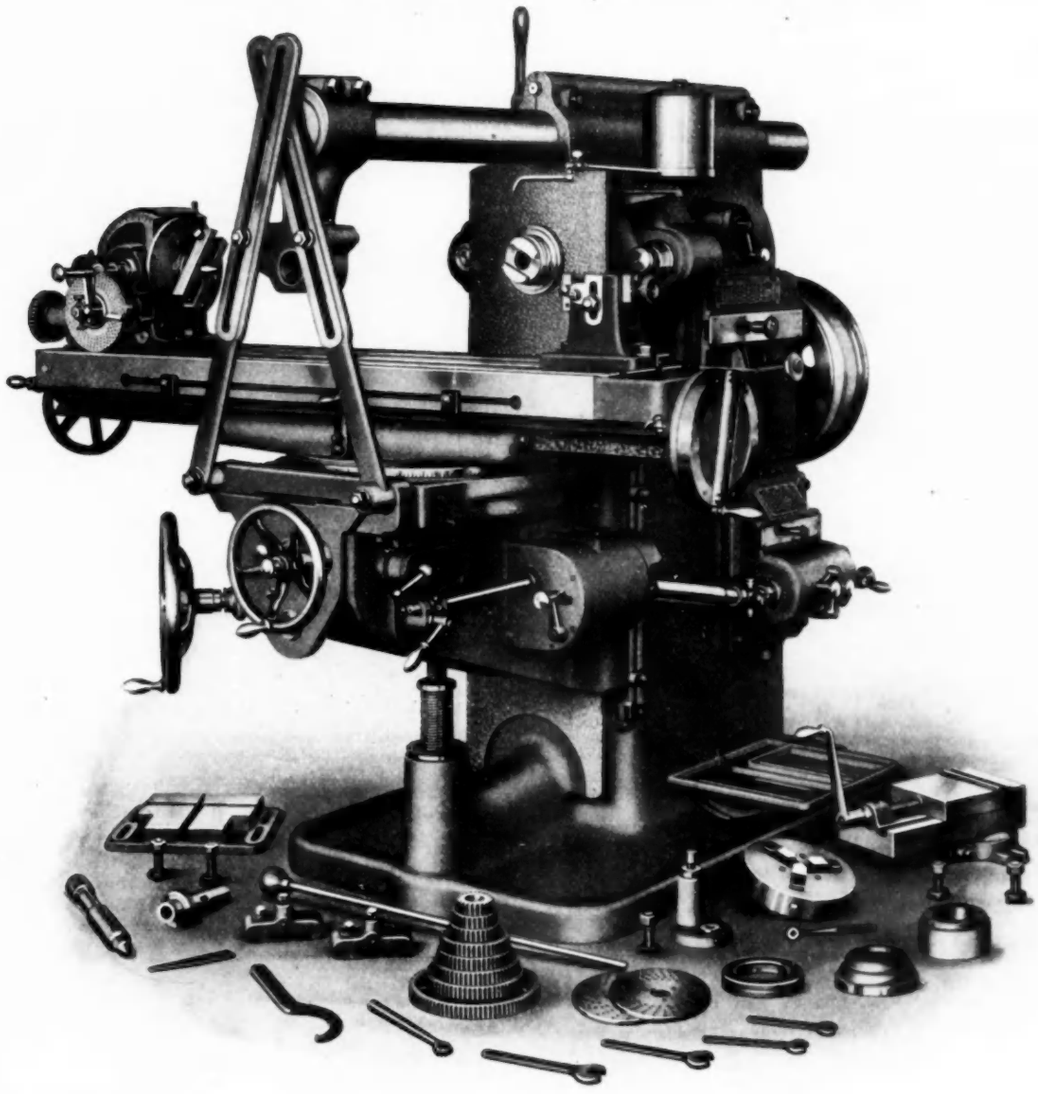

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Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.

Forges
Boynton & Plummer, Worcester, Mass.
Bradley & Son, C. C., Syracuse, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
National Machinery Co., Tiffin, O.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Crescent Forgings Co., Oakmont, Pa.
O. K. Tool Holder Co., Shelton, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Forgings, Steel
Cammel, Laird & Co., New York.
Crescent Forgings Co., Oakmont, Pa
McInnes Steel Co., Corry, Pa.
Tindel-Morris Co., Eddystone, Pa.

Foundry Furnishings
Adams Co., Dubuque, Iowa.
Goldschmidt Thermit Co., New York.
Obermayer Co., S. Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

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Chicago Flexible Shaft Co., Chicago, Ill.
Nash Co., Geo., New York.
Tate, Jones & Co., Pittsburg, Pa.
Westmacott Gas Furnace Co., Providence, R. I.

Furnaces, Enameling
American Gas Furnace Co., New York.

Furnaces, Gas
American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
Westmacott Gas Furnace Co., Providence, R. I.

Furnaces, Melting
American Gas Furnace Co., New York.
Nash Company, Geo., New York.
Obermayer Co., S., Cincinnati, O.
Westmacott Gas Furnace Co., Providence, R. I.

Furnaces, Oil
Tate, Jones & Co., Pittsburg, Pa.

Furniture, Machine Shop
Hart & Cooley Co., New Britain, Conn.
Lyon Metallic Mfg. Co., Aurora, Ill.
Manufacturing Equip. & Engineering Co., Boston, Mass.
Merritt & Co., Philadelphia, Pa.
New Britain Mach. Co., New Britain, Conn.

Gages, Recording
Bristol Co., Waterbury, Conn

Gages, Standard
Ames & Co., B. C., Waltham, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Grönkvist Drill Chuck Co., Jersey City, N. J.
Henry & Wright Mfg. Co., Hartford, Conn.

Gages, Standard—*Continued.*
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Wks., Jno. M., Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., East Boston, Mass.

Gages, Steam
Bristol Co., Waterbury, Conn.
Crosby Steam Gage & Valve Co., Boston, Mass.

Gear Cutting Machinery
Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bilgram, Hugo, Philadelphia, Pa.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnat Shaper Co., Cincinnati, Ohio.
Clough, R. M., Tolland, Conn.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Machine Co., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Newton Machine Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Spacke Mach. Co., F. W., Indianapolis, Ind.
Van Dorn & Dutton Co., Cleveland, O.
Walcott & Wood Mach. Tool Co., Jackson, Mich.
Waltham Machine Works, Waltham, Mass.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Norfolk Downs, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Davis Rodney, Philadelphia, Pa.
Earle Gear & Machine Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Fawcus Mach. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Machine Co., Chicago, Ill.
Gleason Works, Rochester, Mass.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, Ohio.
Lea Equipment Co., New York.
New Process Rawhide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa
Sawyer Gear Works, Cleveland, O.
Spacke Mach. Co., F. W., Indianapolis, Ind.
Taylor-Wilson Mfg Co., McKees Rocks, Pa.
Van Dorn & Dutton Co., Cleveland, O.
Walcott & Wood Mach. Tool Co., Jackson, Mich.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., H. H., Syracuse, N. Y.

Gears, Molded—*Continued.*
Horsburgh & Scott Co., Cleveland, Ohio.
Philadelphia Gear Works, Philadelphia, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton Co., Cleveland, O.

Gears, Rawhide
Boston Gear Works, Norfolk Downs, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Earle Gear & Mach. Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Horsburgh & Scott Co., Cleveland, O.
New Process Rawhide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Works, Cleveland, O.
Van Dorn & Dutton Co., Cleveland, O.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Works, Norfolk Downs, Mass.
Eberhardt Bros. Mach. Co., Newark, N. J.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Fawcus Mach. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, O.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Taylor-Wilson Mfg. Co, McKees Rocks, Pa.
Van Dorn & Dutton Co., Cleveland, O.

Generating Sets
Burke Electric Co., Erie, Pa.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Sturtevant Co., B. P., Hyde Park, Mass.
Triumph Elec. Co., Cincinnati, O.

Generators, Gas
American Gas Furnace Co., New York.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Gem Mfg. Co., Pittsburg, Pa.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincinnati, O.
Mueller Machine Tool Co., Cincinnati, O.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cin., O.

Grinders, Cutter
Bath Grinder Co., Inc., Fitchburg, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.
Crocker-Wheeler Co., Ampere, N. J.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll Milling Mach. Co., Rockford, Ill.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Norton Grinding Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett Lathe Mfg. Co., Boston, Mass.
U. S. Electrical Tool Co., Cincinnati, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Cylindrical
Bath Grinder Co., Inc., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Mach. Co., Worcester, Mass.
Landis Toool Co., Waynesboro, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Norton Grinding Co., Worcester, Mass.

Grinders, Disc
Bath Grinder Co., Inc., Fitchburg, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Diamond Machine Co., Providence, R. I.
Gardner Machine Co., Beloit, Wis.
Heald Mach. Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, Mass.
Taylor & Fenn Co., Hartford, Conn.

Grinders, Drill
Heald Mach. Co., Worcester, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Robinson Tool Works, Waterbury, Conn.
Safety Emery Wheel Co., Springfield, Ohio.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
U. S. Electrical Tool Co., Cincinnati, Ohio.
Wilmarth & Mormon Co., Grand Rapids, Mich.

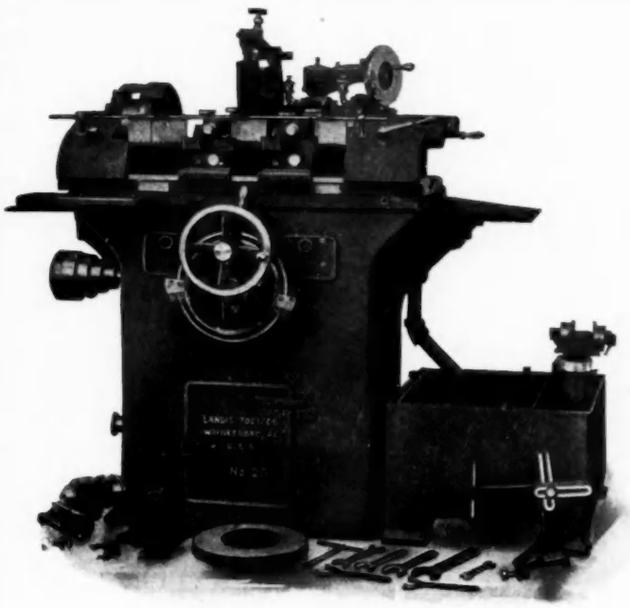
Grinders, Internal
Bath Grinder Co., Inc., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Mach. Co., Worcester, Mass.
Landis Tool Co., Waynesboro, Pa.
Rivett Lathe Mfg. Co., Boston, Mass.
U. S. Electrical Tool Co., Cincinnati, O.

Grinders, Knife
American Wood Working Mchy. Co., Rochester, N. Y.
Safety Emery Wheel Co., Springfield, O.

Grinders, Portable
Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincinnati, O.
U. S. Electrical Co., Cincinnati, Ohio.

Grinders, Saw
Tindel-Morris Co., Eddystone, Pa.

Grinders, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bath Grinder Co., Inc., Fitchburg, Mass.
Blount Co., J. G., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnati, O.
Cincinnati Milling Machine Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Diamond Machine Co., Providence, R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Harrington, Son & Co., Edwin, Philadelphia, Pa
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
McCabe, J. J., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Mummert, Wolf & Dixon Co., Hanover, Pa.
Niles-Bement-Pond Co., New York.
Norton Grinding Co., Worcester, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Robinson Tool Works, Waterbury, Conn.
Rockford Drilling Mach. Co., Rockford, Ill.
Safety Emery Wheel Co., Springfield, O.
Sellers & Co., Inc. Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
U. S. Electrical Tool Co., Cincinnati, O.
Vandyck Churhill Co., New York.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Conn.



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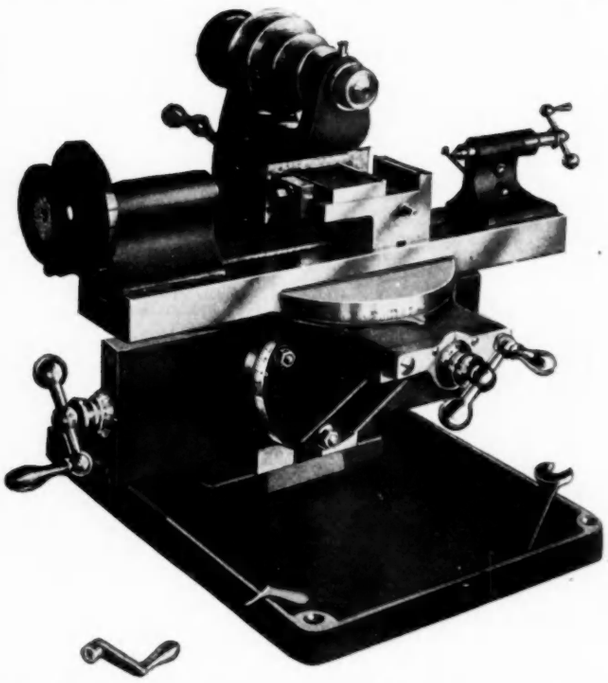

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